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Final technical report

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Report authors: Adalto Bianchini and Christopher Wood

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Principal Investigators:

Adalto Bianchini, adaltobianchini@furg.br

Christopher M. Wood, woodcm@mcmaster.ca

Name & Location of Research Institution:

Universidade Federal do Rio Grande

Instituto de Ciencias Biologicas

Rio Grande, RS, Brazil

McMaster University

Department of Biology

Hamilton, ON, Canada

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i. Basic Project Information

Project numbers: 104519-011 (CRC) / 104519-003 (IDRC RC)

CRC: Christopher M. Wood
McMaster University
Department of Biology
Hamilton, ON, Canada
woodcm@mcmaster.ca

IDRC RC: Adalto Bianchini
Universidade Federal do Rio Grande
Instituto de Ciências Biológicas
Rio Grande, RS, Brazil
adaltobianchini@furg.br

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Project Abstract:

Accelerated growth, unplanned development, and rapidly increasing population along Brazil's coast have negatively impacted the environment. Current debates on how to restore, preserve and improve coastal ecosystems demand improved understanding of how natural and anthropogenic activities affect estuaries. Research activities in the scope of the present project have undertaken ecotoxicology modeling for metal release regulatory purposes, and biomonitoring of organic and inorganic contaminants for evaluation of effects on water quality. Using these data, and in collaboration with government agencies, industrial research organizations, NGOs and community stakeholders in Brazil and Canada, the team developed alternative management strategies to guide industrial regulations, human settlement and urban policy in these environmentally and socioeconomically important areas. Patos Lagoon (Rio Grande, RS, southern Brazil) and São Marcos Bay (São Luís, MA, northern Brazil) estuaries were the primary field sites studied as they have similar anthropogenic activity in and around these water bodies. Furthermore, as they represent subtropical and tropical conditions respectively, they allowed us to extend data and models obtained to other areas along the Atlantic coast. McMaster University and Canadian coastal areas also served as an additional laboratory and provided field sites for research and training. The training component involved the collaboration of principal investigators, graduate students and post-doctoral fellows from the Federal University of Rio Grande (Brazil) and McMaster University (Canada). An intense exchange of personnel (graduate students and postdoctoral fellows) from Brazil to Canada and vice-versa was promoted.

ii. The Research Problem

a) *Original Rationale*: Environmental contaminants originating from human activities eventually reach the

coast, via domestic sewage, agricultural runoff, industrial effluents, rainfall and atmospheric deposition. Estuarine and other coastal areas become sites of critical contamination due to this net drainage from the watershed. They are further compromised by the toxicants released during harbor operations, such as metal-based anti-fouling paints and fuel spillage. This large spectrum of emitting sources contributes many different types of organic and inorganic pollutants. These complex mixtures may induce deleterious effects in coastal organisms. In turn, coastal zones are important areas for both natural and aquacultural growth and reproduction for numerous fish and invertebrates. Thus, pollution of this ecosystem is of extreme concern because of its negative economic and ecological impacts. Furthermore, most of the aquatic pollutants are bio-accumulated through food webs, indirectly threatening the health of consumers, which can be aquatic organisms or human beings. In Brazil, the ecological equilibrium of coastal areas is now severely threatened by the increasing organic and inorganic pollution associated with both population and industrial growth. Therefore, there is an urgent need for the development of new methods for the identification, estimation and management of the risk imposed by the indiscriminate discharge of chemical compounds in Brazilian coastal ecosystems. The present proposal aimed to advance these goals.

b) *Scientific Importance*: Research activities proposed within the present program were novel in being both multi- and interdisciplinary. They were concentrated on ecotoxicology modeling (Biotic Ligand Model - BLM) for metal release regulatory purposes, and biomonitoring of water quality with respect to both organic (through biomarker response) and inorganic contaminants (through direct measurement and biomarker response). The development of new methods for the identification, estimation and management of the risk imposed by chemical contaminants disposed in Brazilian coastal ecosystems, as proposed in the present project, were shown to be useful tools to assess the efficacy of regulations at a local level. This is especially important because current Brazilian environmental regulations are largely copied from northern hemisphere countries without a firm scientific understanding of tropical and subtropical ecosystems. The application of these new techniques to assess the efficacy of regulations in coastal ecosystems is novel, providing complementary methodology in environmental monitoring.

c) *Societal/Technical relevance*: Many Brazilian people live in extremely poor conditions. The use of coastal areas occurs without adequate planning or integrated understanding of the environmental support capacity and the influence of natural and anthropogenic activities on water quality. According to Brazilian Federal policy, directives for the implementation of scientific and technological activities linked to coastal sciences are urgently needed to improve sustainable socio-economic development in Brazil. Threats to estuarine and coastal biodiversity, conflicts between aquaculture and other economic activities, degradation of fisheries, and impacts of anthropogenic inputs are listed as the main concerns. The development of new methods for the identification, estimation and management of the risk imposed by chemical contaminants disposed in coastal ecosystems, as performed in the present project, helped to develop new alternative management strategies to guide industrial regulation, human settlement and urban policy in coastal areas in Brazil.

iii. Objectives

The overall objective of the Project was to develop alternative management strategies to guide industrial regulation, human settlement and urban policy in coastal areas in Brazil.

The specific objectives of the Project were as follows:

- To perform ecotoxicology modeling for metal release regulatory purposes using the BLM approach;
- To biomonitor water quality regarding both organic (through biomarker response) and inorganic contaminants (through direct measurement and biomarker response);
- To undertake training of highly qualified personnel in ecotoxicology and pollution regulatory issues; and
- To collaborate with government agencies, industrial research organizations, and community stakeholders with the goal of restoration, preservation and improvement of coastal ecosystems.

iv. Methodology

Methods originally proposed for sampling and analysis in both field and laboratory have proven to be appropriate for metal, hydrocarbons and organochlorine pesticides analyses. However, we faced technical problems to detect organophosphorus pesticides in biological samples collected. Two technical alternatives were tested without success for this analysis. Surface waters were collected seasonally for two years in different sites in the Patos Lagoon estuary (Rio Grande, RS, southern Brazil) and the São Luís estuary (São Luís, MA, northern Brazil). At the time of collection, water pH and temperature, dissolved O_2, salinity, were determined. Filtered (0.45-µm filter for the dissolved component) and non-filtered water samples (for the total metal component) were collected and analyzed for metals concentrations by atomic absorption spectrophotometry (AAS) associated or not with graphite furnace, depending on the metal and concentration to be detected. Cation (Na^+, K^+, Ca^{2+}, Mg^{2+}) concentrations were determined in filtered samples by AAS. Anion concentrations were measured by spectrophotometry in filtered samples using a commercial reagent kit for Cl^- and the method of Tabatabai (1974) for SO_4^{2-}. Alkalinity was measured using the method described by the American Public Health Association (1989). Dissolved organic carbon concentration was measured using a total carbon analyzer. Data on these physicochemical parameters were used in the scope of the BLM approach. BLM is a computacional tool developed and calibrated for freshwater invertebrates and fish which allow us to predict the bioavailability and toxicity of metals. Therefore, it is important to note that this model was only validated and calibrated for freshwater systems, thus needing more information to be extended to brackish and salt water, as performed in the present study. In order to assess the effectiveness of BLM predictions from direct metal monitoring, biological samples were collected for evaluation of two biomarkers of chronic metal exposure (metallothionein concentration, tissue metal residues). In addition, biological samples were also collected for analyses of other biomarkers. They were analyzed in whole body (copepods) or selected tissues (fish and crabs) as appropriate. Biomarkers included those considered specific for exposure to a variety of hydrocarbons (CYP 450 activity) and pesticides (acetylcholinesterase activity) as well as oxidative stress biomarkers (lipid peroxidation). Biomarkers were assayed in at least 5 individuals (fish and crabs) or pools of individuals (copepods) of each species collected in the sampling sites. After collection, fish were immediately euthanized with benzocaine (200 ppm) while crabs and copepods were cryo-anaesthetized on ice. Biometric data for fish (body weight; total and standard lengths) and crabs (body weight; carapace width) were obtained. Muscle, gills, brain/cerebral ganglia and liver/hepatopancreas of fish/crabs were also dissected. Liver/hepatopancreas/whole body (fish/crabs/copepods) samples were separated into sub-samples, immediately frozen and transferred to the laboratory. One set of sub-samples was digested in HNO_3 and

analyzed for metals (currently Ag, Cu, Zn, Cd, Fe, Ni, and Pb). The other sets of sub-samples were prepared for pesticides, hydrocarbons and biomarkers analyses. Brain/cerebral ganglia (fish/crabs) and whole body (copepods) samples were used to assay acetylcholinesterase activity. Liver/hepatopancreas (fish/crabs) and whole body (copepods) samples were used for measurements of CYP 450 activity (EROD assay), lipid peroxidation and metallothionein-like proteins concentration. Methodologies described in previous studies with estuarine species from the laboratory of Dr Bianchini were employed (acetylcholinesterase activity: Tortelli *et al.*, 2006; metallothioneins and lipid peroxidation: Zanette *et al.*, 2006). EROD activity was determined by the method of Gagné and Blaise (1993). Data were presented as mean ± standard error and modeled using the Generalized Additive Models (GAM) and Principal Component Analysis (PCA) to identify the most reliable and practical biomarker to use in future biomonitoring programs in the scope of public policies.

v. Project Activities

The project developed in the scope of the IDRC Program was based on four main groups of activities: ecotoxicology modeling for metals using the BLM and GAM; biomonitoring of water quality regarding organic and inorganic contaminants using biomarkers; training of highly qualified personnel; and collaboration with government agencies, industrial research organizations, NGOs, and community stakeholders. As originally proposed, research activities involving ecotoxicology modeling for metal release regulatory purposes and biomonitoring of water quality regarding organic (through biomarker response) and inorganic contaminants (through direct measurement and biomarker response) were performed in both subtropical (Patos Lagoon estuary, Rio Grande, Rio Grande do Sul state, southern Brazil) and tropical (São Marcos Bay, São Luís, Maranhão state, northern Brazil) coastal areas. Sampling and studied sites included River, Lake and Beach Fronts in both Patos Lagoon estuary (Fig. 1) and São Marcos Bay (Fig. 2).

The Patos Lagoon is the largest coastal lagoon in South America. It is the recipient of almost all the rainwater falling in southern Brazil, which drains pastures, crop fields and large urban areas. Around 3 million people are living and depend on the Patos Lagoon for industrial, domestic, harboring and agricultural activities. Therefore, a complex mix of chemical contaminants (metal, hydrocarbons and pesticides) is released into the Patos Lagoon waters. Rio Grande City is located in the border of the estuarine area of the Patos Lagoon, where waters from the lagoon flow into the southern Atlantic Ocean. In this context, the “Mangueira Inlet” is a very important area of the Patos Lagoon estuary associated with the Rio Grande City development. Historically, this area was considered as a major site for reproduction and/or growth of shrimp and fish species of commercial importance, being exploited exclusively by artisanal fishermen. However, the “Mangueira Inlet” is now well recognized as an estuarine area which is heavily impacted by chemical contaminants. Over decades, one of the borders of this estuarine area was disorderly occupied by human settlement associated with the development and expansion of the Rio Grande City urban area. In turn, the opposite border was occupied by the Rio Grande “industrial district”, which involves industrial and harbor activities. Today, the Rio Grande harbor is one of the most important harbors in Brazil. In turn, industrial activities include oil refinery and production of fertilizers, soya bean oil, ammonia, among other types of activities associated with chemical industries. An important part of the industrial effluents from the industrial district is actually released into the “Mangueira Inlet”. In addition, there is an input of domestic

effluents to this estuarine area as a contribution from the fresh water flowing from the urban creeks into the "Mangueira Inlet", since a significant part of the population is actually living around these creeks. In summary, this estuarine water body receives domestic effluents from one side and industrial effluents from the other side (Fig. 1).

Figure 1. *Different fronts (river, lake and beach) evaluated and monitored in the Patos Lagoon estuary (Rio Grande, RS, southern Brazil) during the development of the IDRC project.*

In addition to the background above, it is important to note that a settlement of 78,582-104,772 new habitants is estimated to occur around the drainage basin of the urban creeks until 2020. The current population of Rio Grande City is around of 210,000 people. Therefore, an explosive increment in population is expected to occur in less than one decade. This explosive increment in population can directly affect the water quality of two preserved creeks (Bolaxa and Senandes) and severely increase the actual impact in one of the creeks (Vieira). This urban growth is being driven by Federal, State and Municipal investments now taking place in Rio Grande City. These investments are majorly focused on the following macro vectors of local/regional development: (a) naval pole and off-shore structures; (b)energetic pole; (c) trans-shipment logistics; (d) touristic pole; and (e) re-organization of chemical and food poles.

In light of the above, the main idea of our program was to drive decision makers to take actions in order to maintain the water quality of the preserved creeks showing good conditions, as well as to avoid an increment in deterioration of creeks already impacted and even to improve the quality of their waters. The monitoring performed by our research group, as described below in detail, is quite important considering

the fact that these six urban creeks flow into the Patos Lagoon estuary, thus contributing a significant amount of chemical contaminants from domestic effluents. Therefore, improvement in the quality of fresh water running into the Patos Lagoon certainly helps in preserving the quality of the estuarine waters. In turn, considering the huge differences in water chemistry between fresh and salt waters, as well as the fact that effluents released and flowing into the estuarine waters are characterized as a complex mixture of chemicals, the application of the BLM for the estuarine waters was less indicated. Therefore, we applied biomarkers, as an alternative tool, to monitor the water quality of the estuarine area of the Patos Lagoon.

In turn, the Maranhão State is one of the biggest states in northern Brazil with a transition zone with the Amazon region, thus showing a great biodiversity. It is known by its extensive coastal region (approximately 640 km long) with the major part being constituted by mangroves (500 km), which performs 50% of all mangrove areas in Brazil. Associated with this transition area, the Maranhão state is well marked by pluviometric and climate variations, being characterized by two distinct seasons: dry (from January to July) and wet (from August to December). Therefore, its waters show great seasonal variation in physicochemical parameters. In addition, the coastal zone of Maranhão can be considered as the most impacted estuarine ecosystem in Brazil. This impact is associated with siltation and chemical pollution through the discharge of industrial, harbor and urban effluents, as it can be seen in the Patos Lagoon estuary in southern Brazil.

The São Luís Island divides the the "Maranhense Gulph" into two main parts, one constituted by the São Marcos Bay at west, which comprises the Grajaú, Pindaré and Mearin Rivers. The other part is formed by the São José Bay at east, which comprises the Munin and Itapecuru Rivers (Fig. 2). The São Marcos Bay - estuarine area of São Luís, the capital of the Maranhão state - constitutes the main inflow of water into the Maranhão state, which is made through the Mearin River. It is known by its high hydrodinamics, with a semidiurnal tide cycle which can achieve up to 7.2 m high. The São Marcos Bay is considered as an important fishing area and hosts the major harbor of the region, with several companies dealing with metals (e.g., Alumar and Companhia Vale do Rio Doce), as well as oil production and refinement (e.g., Petrobras). The Alumar harbor, known as the Itaqui harbor, is involved with minerals transport, but also receives caustic soda, mineral charcoal, pitch and bauxite, which are used in the production of aluminum. In turn, the Ponta da Madeira harbor, which belongs to the Companhia Vale do Rio Doce, is involved with iron ore export. In addition to the industrial contamination, the São Marcos Bay is being highly contaminated with urban seawage and agricultural residues (pesticides) in the last decade. The São José Bay is limited at west by the São Luís Island, which isolates it from the São Marcos Bay, and at east by the island forming the Tubarão Bay. The São José Bay is a continuation of the Itapecuru River estuary, which crosses geological regions which differences are reflected in the morphology and distribution of the sediment deposits. Despite its dimension, localization and ecological importance, there is a lack of knowledge about the human impacts and chemical contamination in the São José Bay.

As for the Patos Lagoon, the uncontrolled used of the coastal zone in the Maranhão state is also increasing the environmental impact and affecting the health of animals living there. However, the biological effects resulting can be varied, mainly when considering the contaminants showing high bioaccumulation potential, high biological efficiency, low or no degradation and sinergic or additive action with other contaminants and/or other environmental stressors, such as metals, hydrocarbons and pesticides. Therefore, the

monitoring of the estuarine area was also performed using the second alternative tool: the biomarkers.

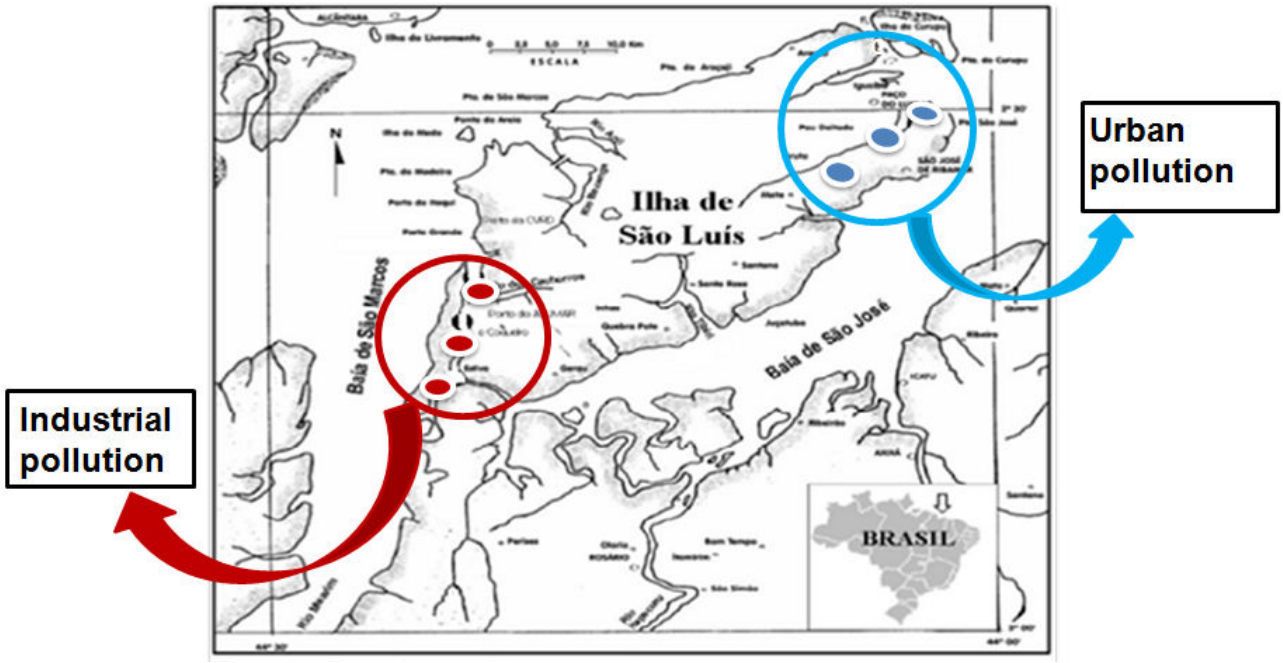

Figure 2. *Different fronts (river, lake and beach) evaluated and monitored in the São Marcos Bay (São Luís, MA, northern Brazil) during the development of the IDRC project.*

To achieve the main research objectives, our research group collected water and biological samples from 3 aquatic species (crabs, croakers and copepods) to determine the applicability of the BLM in the scope of the ecotoxicology modeling for metal release regulatory purposes in the Patos Lagoon estuary. Also, these collections were employed to biomonitor the water quality regarding organic (through biomarker response) and inorganic contaminants (through direct measurement and biomarker response). In this case, the response of different biomarkers of exposure to metals, hydrocarbons and pesticides were evaluated. Samples were collected every season in two different sites along a salinity gradient in the "Mangueira Inlet", as a polluted area. Sampling was also performed in a clean (reference) estuarine area (Barra do Chuí, Chuí, RS, southern Brazil) approximately 220 km distant from the Patos Lagoon. Sampling was performed from the summer of 2011 to the summer of 2013. After analysis, the more effective, adequate and cheap biomarkers were selected for evaluation and monitoring of water quality and ecosystem health in the Patos Lagoon estuary and adjacent coastal area.

It is important to stress that the chemical tools available and used for monitoring the water quality at the beginning of this research project had proven to be inneficient, time consumming and not sufficient to perform an adequate analysis of the risk imposed by the different groups of contaminants present in the freshwater and saltwater systems. Indeed, a much better approach should consider the combination of

chemical and biological indicators of water quality. Furthermore, the use of an ecotoxicological model such as the BLM to analyze and interprete the resulting data would be much more adequate to evaluate and predict the risk imposed by the release of chemical contaminants in both fresh and salt water in the Patos Lagoon estuary and coastal adjancent area. Therefore, all the research activities planed and performed in the scope of the present study were previously discussed and approved by the Municipal Council for Environmental Protection (COMDEMA). In February 2012, COMDEMA has constituted and authorized a working group to discuss more deeply the adequacy of the alternative tools (BLM and biomarkers) for water quality monitoring in the Rio Grande area. The working group was constituted by the following members: Municipal Secretariat of Environment; Federal University of Rio Grande; Environmental Research Institute "Friends of Nature" - NGO; "Friends of Vieira Creek" Association – NGO; Rio Grande Industry Center (CIRG); Rio Grande Trade Chamber; Society of Engineers and Architects of Rio Grande (SEARG); and Association of Inhabitants of the San Peter Park - NGO. As discussed and approved by COMDEMA, it was expected that the alternative tools could be adopted and put into the environmental regulatory framework aiming to monitor the water quality in estuarine and coastal waters around Rio Grande City. As a first step, a workshop was realized in July 26, 2012. A large number of agencies and institutions were represented during this workshop, such as the Municipal Council for Environmental Protection (COMDEMA); International Development Research Centre (IDRC – Ottawa – Canada); State Foundation for Environmental Protection (FEPAM-RS) - Central State Office; State Foundation for Environmental Protection (FEPAM-RS) - South Region Office; State Company of Sanitation (CORSAN); Chico Mendes Institute for Protection of the Biodiversity (ICMBio); Rio Grande Industry Center (CIRG); Municipal Secretariat of Coordination and Planning (SMCP); Municipal Secretariat of Health (SMS); Municipal Secretariat of Environment (SMMA); Biological Sciences Institute (University of Rio Grande); Oceanography Institute (University of Rio Grande); Chemistry and Food School (University of Rio Grande); Education and Environmental Monitoring Center (NEMA) – NGO; and Friends of Nature – NGO. Participants presented and discussed themes such as: (a) macro vectors of local/regional development; (2) actual water quality criteria for fresh and salt waters in the Patos Lagoon area (southern Brazil); (3) technical basis of the BLM; (4) water chemistry monitoring of 6 urban creeks from the Rio Grande area; (5) application of the BLM for the urban creeks and future scenarios; (6) legal aspects involved in the application of the BLM into the local environmental regulation framework; (7) future research efforts and activities in coordination with COMDEMA.The second workshop with local stakeholders and decision makers was held in November 06, 2012. In this workshop, the application of the biomarker approach to monitor estuarine and coastal waters around Rio Grande City was discussed. All the participants involved in the first workshop of July 2012 were invited to participate in the second workshop of November 2012. Folllowing these workshops, several other deliberative meetings were performed during 2013 and 2014 with the working group, COMDEMA and legislation consultants to discuss and approve the inclusion of the two alternative tools (BLM and biomarkers) into the local environmental regulatory framework.

Therefore, a very positive scenario for the development and implementation of both alternative methods (BLM approach, biomarker approach) proposed for water quality monitoring was created and largely enriched with support of the IDRC Program. As a result of the large number of meetings with environmental regulatory agencies and decision-makers, both fundamental and applied research projects were initiated by the Municipal Council for Environmental Protection (COMDEMA). Dr Bianchini led the work group from COMDEMA responsible for the development and application of the knowledge on the use of these two

approaches. In the scope of the ecotoxicological modeling approach, the Biotic Ligand Model (BLM) was applied to evaluate the loading capacity of six urban creeks for metals (cadmium, copper, lead and zinc) considering twelve physicochemical parameters of the water, including metals concentration. The creeks monitored (Bolaxa, Senandes, Vieira, Cabeças, Martins, and Barrancas) are unique water resources within the Rio Grande urban area and all of them flow into the "Mangueira Inlet", which is a very important and heavily impacted site of the Patos Lagoon estuary, as described above. Three of these creeks were described as now impacted by urban growth, thus contributing significantly for estuarine and coastal contamination with domestic effluents. Notably, the metals monitored (cadmium, copper, lead and zinc) are among the major contaminants in domestic effluents. In contrast, three of the creeks monitored were shown to be still under preservation by Federal and State regulations. Therefore, application of the BLM clearly showed that preserved creeks display higher loading capacity for metals than those impacted by domestic effluents.

As a final result, the monitoring of the urban creeks water quality in the estuarine area in Southern Brazil using the ecotoxicology modeling for metal release regulatory purposes, as performed by the research group, was approved by the local environmental agency (COMDEMA - Conselho Municipal de Defesa do Meio Ambiente). This action was imperative to improve the quality of estuarine waters from the Patos Lagoon. In turn, public actions to revitalize the "Mangueira Inlet" were also approved by the Brazilian Ministry of Cities (Brasília, DF) and are being put in place under the charge of the Secretariat of Coordination and Planning and the Secretariat of Environment of Rio Grande. In addition, the other alternative tool (biomarkers) proposed by the research group was also approved by the local environmental agency and is now being used to derive water quality criteria to evaluate and monitor the water quality and ecosystem health, as well as the possible improvement in water quality after the revitalization of the "Mangueira Inlet" as a consequence of the public actions. This approval was officially put in place in July 11, 2014 through the publication of the COMDEMA Resolution 002/2014.

Collection of water and biological samples for biomarkers analysis, as described above for the Patos Lagoon estuary in southern Brazil, was also performed in the Amazon region (São Marcos Bay, São Luís, MA, northern Brazil). In this case, collections in the tropical region were performed in three different sites in two different regions in the wet (winter) and dry (summer) seasons from 2012 until 2014 (Fig. 2). As originally proposed, the idea was to compare the response of biomarkers of exposure to chemical contaminants (metals, hydrocarbons and pesticides) in the different aquatic species (crabs, croakers and copepods) in subtropical (Patos Lagoon) and tropical (Amazon) regions. This allowed the research group to validate the application of the biomarker approach also to tropical coastal areas. To achieve this objective, data on water physicochemical parameters, contaminants (metals, hydrocarbons and pesticides) and biomarkers responses in copepods, crabs and croakers obtained in both subtropical (Patos Lagoon estuary) and tropical (São Marcos Bay) estuaries were analyzed, compared and discussed using the statistical GAM modeling and PCA analysis. All scientific results obtained by the research group in the Patos Lagoon estuary and the results available until October 2013 for the São Marcos Bay were presented by undergraduate students, graduate (MSc and PhD) students and principal investigators during the Brazilian Congress of Aquatic Toxicology (CBTAq). This meeting was organized by the research group and held in November 4-8, 2013 at the Federal University of Rio Grande (Rio Grande, RS, southern Brazil). Additional data obtained after October 2013 were presented and discussed in two different meeting in Canada and Brazil (23rd Annual Comparative

Physiology and Biochemistry Workshop, January 31-February 1-2, Elmhirst's Resort, Keene, ON, Canada; and 13ª Mostra da Produção Universitária, October 14-17, Rio Grande, RS, Brazil).

In addition to the research activities, it is also important to stress the enhanced training environment created by the IRCI. All field and laboratory activities increased significantly the opportunites for trainees to develop their skills in the aquatic toxicology and environment protection and conservation fields. HQP training was always a constant and main component of the project developed in the scope of the IDRC Program. In total, 81 people were trained at different levels (undergraduate, MSc, PhD and post-doctoral) over the 5-year project. Also, it is worth to mention the increased collaboration with government officials involved in environmental regulatory issues in Brazil. Activities developed in a cooperative way with government officials, community stakeholders, industrial managers, and NGOs were critical for training of undergraduate and graduate students, as well as post-doctoral fellows. In this case, opportunities created helped significantly in training people more responsible towards the monitoring and preservation of water quality and ecosystem health. On the professional side, seven of the trained people are now hired as faculty members in Federal or State Universities in Brazil (Camila de Martinez Gaspar Martins, Indianara Fernanda Barcarolli, Christianne Lorea Paganini, Indianara Fernanda Barcarolli, Isabel Soares Chaves, Vania Vera Loro and Samantha Eslava Gonçalves Martins), two are hired as laboratory technicians in a Federal University in Brazil (Sandra Carvalho Rodrigues and Thaís Martins Lopes), and three have postdoctoral fellowships (Lygia Sega Nogueira, Marianna Basso Jorge, and Mariana Machado Lauer). In addition, one PhD student is hired as environmental agent in the local Secretariat of Environment (Daiane Marques de Miranda). Three of the Canadian trainees now have faculty positions (Kevin Brix, Hassan Al-Reasi, Joel Klinck), one has an NGO position (Margaret Tellis), and one has a postdoctoral fellowship (Erin Leonard). It is important to note that 65% of trainees were females.

Finally, it is important to mention the increased capability of the research group in creating and maintaining established networks for cooperative work in science and development. The Brazilian network on "Aquatic Toxicology" (www.inct-ta.furg.br) was created and expanded, involving initially main researchers from 5 Federal Universities (Federal University of Rio Grande, Federal University of Santa Catarina, Federal University of Paraná, Federal University of Pernambuco, and Federal University of São Carlos) and 1 State University (State University of Londrina). The extension of this research network was proposed in August 2014, but now involving 10 Federal Universities (Federal University of Rio Grande, Federal University of Santa Catarina, Federal University of Paraná, Federal University of Pernambuco, Federal University of São Carlos, Federal University of Santa Maria, Federal University of Espírito Santo, Federal Rural University of Pernambuco, Federal University of Pará and Federal University of Maranhão), 3 State Universities (State University of Londrina, State University of Santa Catarina, and State University of Northern Paraná), and 2 Private Universities (University of the Itajaí Valley and University of Vila Velha). This research network has been continuously supported by the National Council for Science and Technology (CNPq, Ministry of Science and Technology). Also, as a result of the networking activities developed by the research group, the Brazilian research network on "Biomarkers of Contaminants in Coastal and Marine Environments" - Marine Science Program - was created and expanded, involving actually 5 Federal Universities (Universidade Federal do Rio Grande, Universidade Federal de Santa Catarina, Universidade Federal do Maranhão, Universidade Federal Rural de Pernambuco, Universidade Federal do Rio de Janeiro) and 1 State University (State University of Santa Cruz). This second network is continuously supported by the Coordination of High-Qualified Personnel

(CAPES, Ministry of Education). Both networks are headed by Dr. Bianchini, the IDRC RC.

On the CRC side, the opportunities provided by the IDRC – IRCI program also enriched and enhanced in all the categories considered in the scope of the Program. As a result of interactions fostered by the program, the CRC was able to forge many new collaborative links – with colleagues at INPA (the National Research Institute of the Amazon, Manaus, Brazil), Environment Canada, the United Nations University Water, Wilfrid Laurier University, Bamfield Marine Sciences Centre, CIMAR, Porto, Portugal, University of Antwerp, Belgium, and the University of Nairobi, Kenya, and of course with the IDR –IRC, Dr. Bianchini, as a foreign collaborator. With regard to the first of these collaborations (INPA), the CRC was nominated for and received a 3 year Science Without Frontiers Fellowship (2013-2016) from the Brazilian National Funding Agency (CNPq). The application was initiated by the Director of INPA, Dr. A.L. Val, and was supported by the IDRC–IRC, Dr. Bianchini (FURG), and has resulted in stronger linkages between the INPA-led ADAPTA program (Biodiversity of the Amazon) and the FURG-led IDRC program, INCT-TA program (Brazilian Toxicology Network), and Biomarkers of Contaminants in Coastal and Marine Environments network from the Brazilian Ministry of Education. It also enhanced Brazilian training opportunities, providing fellowships for graduate students and PDFs. On the financial side, the CRC was able to obtain NSERC CRD-Industry research grants to study aspects of metal toxicity in estuarine and coastal waters in Canada, and industrial grants to study metal toxicity in freshwater fish. These have involved important collaboration from the IDRC-RC, Dr. Bianchini, and the research is ongoing.

In light of the above, it is clear that the networking activities developed with support of the IDRC Program enhanced significantly the capability of the research group to obtain extra financial support from different national agencies in Brazil and Canada, as well as international agencies in America and Europe to maintain and expand their research, training, science diffusion and collaborative work with government agencies, industrial research organizations, NGOs and community stakeholders with the goal of restoration, preservation and improvement of coastal ecosystems (see Appendix).

vi. Project Outputs

List of Trainees

	Trainees supervised by IDRC RC	Trainees supervised by the CRC	Trainees co-supervised by IDRC RC & CRC	Trainees supervised by other collaborators
Undergraduate	(1) Anderson Abel de Souza Machado (2) Bruna Barros Furci (3) Eduardo Guerreiro Gomes (4) Gabriel Barboza dos Santos (5) Janaina Goulart Cardozo (6) Jannine Marquez	(1) Margaret Tellis (2) Anu Singh (3) Tarunpreet Dhaliwal (4) Joshua D'Silva (5) Amanda Smith (6) Lisa Robertson (7) Upasana Banerjee (8) Allen Ng (9) Tiffany Chow		

	Lencina Avila (7) José Itamar Ferreira Xavier (8) Juliana da Silva Fonseca (9) Marina Mussoi Giacomin (10) Natália Lie Inocêncio Yano (11) Nayguel Prado Cappellari (12) Priscila Emerich Souza (13) Rafael de Oliveira Jaime Sales (14) Sidnei Braz Afonso (15) Tarine Silveira Siveira (16) Vinicius Cavicchioli Azevedo (17) Vinícius Dias Borges	(10) Michael Lim (11) Usman Yousaf (12) Vanaja Sivakumar (13) Dhanisha Patel		
Masters	(1) Anderson Abel de Souza Machado (2) Arthur Juan Costa Mathias (3) Bruna Duarte Pereira Righi (4) Cindy Tavares Barreto (5) Cinthia Carneiro da Silva (6) Cyntia Ayumi Yokota Harayashiki (7) Evelise Sampaio da Silva (8) Joseane Aparecida Marques (9) Laís Donini Abujamara (10) Laura Fernandes de Barros Marangoni (11) Lygia Sega Nogueira (12) Marianna Basso Jorge (13) Marina Mussoi Giacomin (14) Martina de Freitas Prazeres (15) Paloma Calábria Carvalho (16) Roberta Daniele Klein (17) Vinícius Dias Borges	(1) Margaret Tellis (2) Tamzin Blewett (3) Alex Zimmer (4) Josias Grobler (5) Lisa Robertson	(1) Anderson Abel de Souza Machado (2) Margaret Tellis (3) Marina Mussoi Giacomin (4) Lisa Robertson	(1) Anderson Abel de Souza Machado (2) Marina Mussoi Giacomin (3) Lisa Robertson (4) Rachel Diamond (5) Victoria Rainsberry
Doctoral	(1) Camila de Martinez Gaspar Martins (2) Cinthia Carneiro da Silva	(1) Alex Zimmer (2) Erin Leonard (3) Hassan Al Reasi	(1) Alex Zimmer (2) Camila de Martinez Gaspar	(1) Lygia Sega Nogueira (2) Mariana Machado Lauer

	(3) Daiane Marques de Miranda (4) Indianara Fernanda Barcarolli (5) Iuri Salim Abou Anni (6) Lygia Sega Nogueira (7) Mariana Machado Lauer (8) Marianna Basso Jorge (9) Roberta Daniele Klein (10) Sandra Carvalho Rodrigues (11) Tatiana Ramos Ávila (12) Thaís Martins Lopes	(4) Joel Klinck (5) Marina Mussoi Giacomin (6) Tamzin Blewett	Martins (3) Daiane Marques de Miranda (4) Erin Leonard (5) Lygia Sega Nogueira (6) Mariana Machado Lauer (7) Marianna Basso Jorge (8) Kassio Rios da Silva	(3) Marianna Basso Jorge (4) Jessica Dutton (5) Julie Marentette (6) Hong Liew
Post-doctoral	(1) Alessandra Rocha Martins (2) Camila Dalmolin (3) Christianne Lorea Paganini (4) Indianara Fernanda Barcarolli (5) Isabel Soares Chaves (6) Patrícia Gomes Costa (7) Samantha Eslava Gonçalves Martins (8) Tatiana Ramos Avila	(1) Anne Cremazy (2) Derek Alsop (3) Ishaq Ahmed (4) Kevin Brix (5) Michele Nawata (6) Rafael Duarte (7) Tania Ng (8) Vania Veira Loro	(1) Indianara Fernanda Barcarolli (2) Lygia Sega Nogueira (3) Marianna Basso Jorge (4) Mariana Machado Lauer	(1) Amit Sinha
Other		(1) Som Niyogi (sabbatical visitor)		

IRCI Training Environment: Overall, how has the IRCI enhanced the training environment you could otherwise provide to your students?

	Not at All	Minimal	Moderate	Significant	Don't know
CRC				x	
IDRC RC				x	

As described above, the IRCI significantly enhanced the training environment, especially for graduate students and post-doctoral fellows. This is notable not only through the refinement of alternative techniques to evaluate and monitor estuarine and marine environments (biomarkers, ecotoxicological modeling, tissue residue approach, etc.), but also in the easy approach to apply these tools for environmental regulatory purposes. These tools were used in most of the research developed in the scope of both undergraduate and graduate student theses under the IDRC RC and CRC supervisions. In turn, funding provided through the IDRC RC continuously increased the research capability of the group to use

more advanced and refined techniques of both chemical and biological analyses. Also, a very significant enhancement in the training environment was given by the official agreement for the exchange program for graduate students training signed between FURG (Brazil) and McMaster University (Canada) in 2009. During the project development, 13 graduate students (9 Brazilians and 4 Canadians) have benefited from the present exchange program. This opportunity significantly enhanced HQP's motivation to develop joint research and exchange cultural experiences, including the improvement of English language skills for Brazilian students and of Portuguese skills for Canadian students.

Cumulative list of research outputs by type

Type	Total number of Research Outputs
Journal Articles (published / accepted)	60
Journal articles (still in submission process)	11
Conference Papers	222
Presentations (non-academic)	5
Books	2
Book Chapters	4
Newspapers / other media	17
Theses	
- MA / MSc	25
- PhD	15

vii. Project Outcomes

Results obtained in the scope of the research activities performed by the research group allowed us to identify a set of biomarkers which can be now applied as an alternative tool in biomonitoring of impacted estuarine and coastal waters at the coastal zones in tropical and subtropical areas. Additionally, the dataset on the physicochemical parameters of the waters collected can be used for ecotoxicological modeling of metal contamination in different sites of the studied areas. All these tools were discussed with local regulatory agencies and decision-makers throughout the five years of project, and this interaction will be continued in the future. A set of discussions on the application of the Biotic Ligand Model (BLM) for modeling metal contamination in waters flowing into the estuarine areas was discussed and debated in the scope of two workshops and one national congress promoted and organized in the scope of the IDRC project. As previously reported, a positive political scenario for including these methods and techniques as complimentary tools in the local environmental regulations for evaluation and monitoring of the water quality was created. Furthermore, a positive atmosphere for discussion and debate with local regulatory agencies and decision-makers was also created for the implementation of biomarkers of organic and inorganic contamination in estuarine waters of the Patos Lagoon. The importance of the implementation of both alternative monitoring tools (BLM, biomarkers) was effectively recognized by the societal representatives involved in discussions and debates. As a result, in July 11, 2014, the Resolution 002/2014 from the local environmental agency (COMDEMA) was released. This Resolution establishes the use of the

alternative tools studied in the scope of the IDRC project (BLM approach and biomarkers) to derive water quality criteria in fresh, brackish and sea water in the Patos Lagoon estuary and adjacent coastal area. Also, as an important advancement, four research trips to the Amazon region were performed in two different years in order to collect water and biological samples. Results obtained allowed us to compare the response of exposure and effect biomarkers in similar species in tropical and subtropical regions. They clearly showed that biomarker responses in copepods, crabs and croakers are dependent on the level of contaminants accumulated in the animal tissues, irrespective the sampling site and the coastal area evaluated. This clearly indicates that the biomarker approach is a reliable tool to evaluate and monitor the water quality and the ecosystem health in both tropical and subtropical coastal areas. As previously mentioned, and also of critical relevance, a significant number of high-qualified personnel were continuously trained over the five years of the IDRC project. These personnel are now prepared to deal with different aspects of the biological monitoring approach, including the tools developed in the scope of this project, in estuarine and coastal areas. Taken altogether, the bulk of actions performed in support of the IDRC project turned out very positively, and will certainly help local regulators and decision-makers in improving significantly the health and quality of waters used for fishing, harboring, and leisure around the Patos Lagoon estuarine and coastal area in southern Brazil. Finally, these actions will certainly guide and help regulatory agencies and decision-makers from other Brazilian coastal regions concerned with chemical contamination of waters under their jurisdiction.

During the development of the present project, the following research outputs were generated:

- **Research protocols for metal analysis in liquid samples**: protocols for measurement of the concentration of several metals (Ag, Cd, Cu, Fe, Pb, Zn) in saltwater were applied.
- **Research protocols for metal analysis in biological samples**: protocols for measurement of the concentration of several metals (Ag, Cd, Cu, Fe, Pb, Zn) in tissue samples of estuarine invertebrate and fish were applied.
- **Research protocols for biomarker analysis in tissue samples**: protocols for measurement of several biomarkers in tissues of the blue crab *Callinectes sapidus* and the croaker *Micropogonias furnieri*, as well as in the whole body of the copepod *Acartia tonsa* were applied. Biomarkers included were those for measurement of lipid peroxidation level, acetylcholinesterase activity, CYP 450 (EROD) activity and metalothionein-like proteins (MTLP) concentration.
- **Newspaper and magazine articles**: several actions aiming science diffusion were performed describing activities developed in the scope of the IDRC program in Brazil.
- **Research papers**: 222 research papers were presented (oral or poster presentations) in national and international conferences.
- **Research articles**: 60 research articles were published or are already accepted for publication in scientific journals of high impact factor in the aquatic toxicology field. Also, 11 research articles are in submission process. These research articles deal with the toxicological effect of metals and mixture of contaminants in aquatic fish and invertebrates. They bring valuable information to the understanding of the mechanisms of accumulation and toxicity of metals in aquatic animals, thus helping the development and calibration of the Biotic Ligand Model (BLM) for estuarine and coastal waters. The BLM was the platform selected to model our data on the bioavailability and toxicity of metals in the scope of the present project. Furthermore, information published also helped us in the identification and application of the

multi-biomarker and tissue residue approach for biomonitoring of water contamination with metals and mixtures of contaminants, as proposed in the present project

- **Knowledge transfer material**: one technical manual (digital and printed) on the fundamentals and application of the ecotoxicological modeling for metals was updated. This manual contains all the basic information on sources of metal contamination in the environment, properties and characteristics of metals in the aquatic environment (speciation, bioavailability and toxicity), use and application of toxicity tests with aquatic organisms in water quality monitoring and management, technical and scientific basis of the Biotic Ligand Model (BLM), as well as its application in water quality management and its actual limitations. A BLM course (30 h) was administered to professionals and graduate and undergraduate students in six different occasions in different regions of Brazil and one time abroad (Mexico City). Around 200 people (graduate students, technicians, and professionals) were trained to use the BLM for metal release regulatory purposes in coastal waters. A website (www.inct-ta.furg.br) was created in the scope of the Brazilian Aquatic Toxicology network led by Dr. Bianchini. This website is being continuously updated. Also, the first databank on toxicological tests performed with Brazilian native species was created, continuously updated and made available (www.inct-ta.furg.br/bd_toxicologico.php). The CRC, Dr. Wood, conceived, edited, and wrote two chapters for a 2-volume, 18-chapter book in the *Fish Physiology* series: *Volume 31A: Physiology and Toxicology of Essential Metals*, and *Volume 31B, Physiology and Toxicology of Non-Essential Metals* (2012, Ed. C.M. Wood, A.P. Farrell, and C.A. Brauner). The book should serve as a valuable resource for all those interested in the impacts of metals in the marine, estuarine, and freshwater environments.
- **Science diffusion material**: One DVD (10 min) was produced and continuously diffused through the media. This DVD contains scientific information which is easily understandable by people who are otherwise naïve about water contamination and the need for preservation and management of this natural resource. In addition to the DVD, a series of 6 TV programs was produced and continously diffused through the media. This TV series contains all the information on the infrastructure and research activities performed at the 6 universities initially involved in the Brazilian aquatic toxicology network led by Dr. Bianchini for the development and application of biomarkers for freshwater and coastal water quality management.
- **Meetings with decision-makers and stakeholders**: Several meetings took place with the local Secretaries of Environment and Fisheries in Brazil, our partners in the IDRC program. During these meetings, contamination of estuarine and coastal water bodies surrounding the city of Rio Grande and alternatives for monitoring and restoration of the impacted areas were discussed. In addition, around twenty meetings took place in the Brazilian Institute for Environmental Protection (IBAMA) at Rio Grande (RS, Brazil) with the local Council for Environmental Protection. During these meetings, the knowledge on the technical basis and application of the Biotic Ligand Model for modeling the bioavailability and toxicity of metals in aquatic environments and the viability of the application of the multi-biomarker approach for monitoring of water quality in the Patos Lagoon estuary and coastal surrounding areas were discussed. Also, two workshops were organized and held in July and December 2012. Also, a national congress in aquatic toxicology was organized and held in November, 2013 with around 400 participants.
- **Environmental regulatory policy:** as a result of the activities developed in cooperation with decision-makers, community stakeholders, NGOs and government officials, the Resolution 002/2014 of the local Council for Environmental Protection (COMDEMA) was released in July 11, 2014. It is important to note

that this Resolution establishes the use of the alternative tools studied by the research group in the scope of the IDRC project (ecotoxicology modeling and biomarker approach) as reliable and valuable alternative tools to evaluate and monitor the water quality and ecosystem health in coastal areas. As a consequence, these tools are now being used to derive water quality criteria for regulatory purposes considering the impact of both inorganic (metals) and organic (hydrocarbons and pesticides) contaminants in coastal areas in southern Brazil. In addition, data generated in the Amazon region by the research group in the scope of the IDRC project clearly indicate that the biomarker approach can be also applied to evaluate and monitor the water quality and ecosystem health in tropical areas.

viii. Overall Risk and Recommendations

As mentioned above, collaborative work developed in the scope of the IDRC project greatly increased the capability and quality of the IDRC RC group through the resources, connections and facilities provided by the Program. The collaborative relationship provided by the IDRC Program significantly improved the research quality of the IDRC RC, the fast implementation of research findings by research users, and especially the nature of the training/mentoring practices. Brazilian students profited from their interdisciplinary training in Canada, which integrates research in both university (CRC's lab) and government laboratories with coursework and discussions of management policies. In reciprocity, the IDRC RC has hosted Canadian students in his lab, with very successful research outcomes. These visits provided excellent intercultural and role model experiences for both the visiting HQP and the hosting HQP. Also, research developed by the IDRC RC is now even more focused on practical aspects related to environmental regulatory issues regarding estuarine and coastal environments at both national and international levels. Indeed, most of the research performed in the IDRC RC laboratory now directly addresses environmental issues related to contamination of coastal and marine environments, thus aiming to help regulators and decision-makers to improve regulations and good practices towards the conservation and restoration of water resources. The IDRC support also significantly increased the opportunities for young researchers to develop research more focused on environmental contamination and regulatory issues, thus creating a training program for a new generation of professionals more concerned with these aspects. Finally, it should be mentioned the improvement of our capability to interact with local stakeholders, as early described above in detail. In conclusion, the IDRC Program was really well designed. All the mechanisms of interaction between CRC and IDRC-RC were extremely effective. Therefore, we recommend IDRC to keep the Program in the future. Indeed, with additional support of the IDRC Program and the Brazilian National Institute of Science and Technology of Aquatic Toxicology (INCT-TA), we aim to develop future research focused on the refinement of the developed tools and their application at a regional and national scale. In fact, the identification, characterization and modelling of adequate and reliable chemical/biological tools, as well as their application into the environmental regulatory framework was the main research achievement of this project. Therefore, new bioindicators and biomarkers will be identified, characterized and modelled to increase our effectiveness in predicting and evaluating the risk imposed by the release of chemical contaminants in aquatic (fresh and salt water) ecosystems at a large scale in tropical and subtropical areas. Finally, we expect that the most reliable and effective tools derived on the basis of the future research developed can be incorporated into the environmental regulatory framework at local, regional and national levels in the near future.

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(58) Machado, A.A.S.; Gonçalves-Araujo, R.; Teixeira, P.; Garcia, V.M.T.; Bianchini, A. 2014. Effects of zinc on *in vivo* fluorescence, chlorophyll *a* and growth of the diatom *Conticribra weissflogii* (Thalassiosirales, halassiosiraceae). Pan-American Journal of Aquatic Sciences. *In Press.*

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ii. Journal Articles (submitted)

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pollution in the Patos Lagoon estuary (Southern Brazil): Tissue metal accumulation. Science of the Total Environment.

(2) Chaves, I.S.; Bianchini, A. 2014. The croaker Micropogonias furnieri as bioindicator of trace metal pollution in the Patos Lagoon estuary (Southern Brazil): Biomarker responses. Science of the Total Environment.

(3) Leidens, D.; Bianchini, A.; Varela Junior, A.S.; Rosa, C.E.; Calabuig, C.P.; Corcini, C.D. 2014. Lead accumulation and effects in testis of the fowl *Chrysomus ruficapillus* (Fowl: Icteridae). Archives of Environmental Contamination and Toxicology.

(4) Machado, A.A.S.; Ávila, T.R.; Bianchini, A. 2014. *In vitro* effect of metals on the activity of crustacean chitobiase: A potential biomarker for toxicological and ecological studies. Marine Ecology Progress Series.

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(11) Santos, E.F.; Guadagnin, D.L.; Bianchini, A.; Jorge; M.G.; Bergmann, F.; Calabuig, C. 2014. Relationships between metal concentrations in feathers from *Cygnus melanocoryphus* (Anatidae) with sex, age and number of micronuclei in Southern Brazil. Archives of Environmental Contamination and Toxicology.

iii. Conference Papers

(1) Bianchini, A.; Santore, R.C. 2009. The development of an estuarine and marine Biotic Ligand Model for copper. SETAC North America 30th Annual Meeting, November 17-23, New Orleans, LA, USA.

(2) Bianchini, A. 2009. Instituto Nacional de Ciência e Tecnologia de Toxicologia Aquática (INCT-TA). XI Jornada Biológica, November 30 - December 4, Rio Grande, RS, Brazil.

(3) Chaves, I.S.; Martínez, P.E.; Bianchini, A. 2009. Seasonal variations in metal tissue accumulation and biomarkers in the croaker *Micropogonias furnieri* from the Patos Lagoon estuary (Southern Brazil). SETAC North America 30th Annual Meeting, November 17-23, New Orleans, LA, USA.

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(5) Martins, M.G.M.; Almeida, D.V.; Marins, L.F.F.; Bianchini, A. 2009. Effects of waterborne copper on ion-transporting proteins in gills of the euryhaline blue crab *Callinectes sapidus*. SETAC North America 30th Annual Meeting, November 17-23, New Orleans, LA, USA.

(6) Wood, C.M. 2009. Ammonia and urea in fish: the pro's and cons of living in your own nitrogenous wastes. Inaugural lecture, IDRC International Research Chair Program, December, Federal University of Rio Grande, Rio Grande-RS, Brazil.

(7) Wood, C.M. 2009. Physiology and ecology of the Lake Magadi tilapia, a teleost fish adapted to the most extreme environment on earth. Annual Undergraduate Symposium, December, Federal University of Rio Grande, Rio Grande-RS, Brazil.

(8) Wood, C.M. 2009. Regulation and toxicity of metals in aquatic ecosystems. Academicians Symposium: Energy and Environment: Crisis, Opportunities and Challenges, November 5th -6th, Hong Kong.

(9) Wood, C.M. 2009. The Rh proteins: a new paradigm for ammonia excretion in fish. Dept of Biology, Federal University of Curitiba, December, Curitiba-PR, Brazil.

(10) Ávila, T.R.; Bianchini, A. 2010. Efeitos do cádmio e chumbo no crescimento, desenvolvimento e biomassa de náuplios do copépodeA*acartia tonsa*. IV Congresso Brasileiro de Oceanografia, May 17-21, Rio Grande, RS, Brazil.

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(13) Bianchini, A. 2010. Biomarcadores de contaminação aquática: conceitos e aplicações. XXV Reunião Anual da Federação de Sociedades de Biologia Experimental (FeSBE), August 25-28, Águas de Lindóia, SP, Brazil.

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(17) Cardozo, J.G.; Cavicchioli-Azevedo, V.; Lencina-Ávila, J.M.; Klein, R.; Lopes, T.M.; Chaves, I.S.; Barcarolli, I.F.; Rodrigues, S.C.; Paganini, C.L.; Bianchini, A. 2010. Identificação de biomarcadores no siri azul *Callinectes sapidus* para a avaliação de contaminantes aquáticos no estuário da Lagoa dos Patos (RS). VII Encontro de Farmácia de Ribeirão Preto, October 8-12, Ribeirão Preto, SP, Brazil.

(18) Cardozo, J.G.; Cavicchioli-Azevedo, V.; Lencina-Ávila, J.M.; Klein, R.; Lopes, T.M.; Chaves, I.S.; Barcarolli, I.F.; Rodrigues, S.C.; Paganini, C.L.; Bianchini, A. 2010. Variação sazonal de biomarcadores no siri azul *Callinectes sapidus* para a avaliação de contaminantes aquáticos no estuário da Lagoa dos Patos (RS). 9ª Mostra da Produção Universitária (MPU), Universidade Federal do Rio Grande, October 19-22, Rio Grande, RS, Brazil.

(19) Cavicchioli-Azevedo, V.; Lencina-Ávila, J.M.; Cardozo, J.G.; Paganini, C.L.; Lopes, T.M.; Chaves, I.S.; Klein, R.D.; Barcarolli, I.F.; Rodrigues, S.C.; Bianchini, A. 2010. Biomarcadores em *Acartia tonsa* como ferramentas para avaliação de impacto e monitoramento de contaminantes em estuários. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

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(21) Cunha, V.L., Barcarolli, I.F., Bianchini, A., Sampaio, L.A. 2010. Avaliação do crescimento da tainha *Mugil platanus* em diferentes salinidades. Aquaciência, September 12-15, Recife, PE, Brazil.

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(23) Giacomin, M.M.; Martins, C.M.G.; De Menezes, E.J. Bianchini, A. 2010. Avaliação do stress oxidativo e defesas antioxidantes em brânquias do siri-azul *Callinectes sapidus* após choque hiposmótico e exposição ao cobre. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(24) Inocêncio, N.; Lauer, M. M.; Bianchini, A. 2010. Efeito do cobre sobre a atividade de enzimas do metabolismo energético na anêmona-do-mar *Actinia sp*. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

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(26) Lauer, M., Inocencio, N., Oliveira, C., Bianchini, A. 2010. Effects of copper on the energy metabolism in the euryhaline crab *Neohelice granulata*. North America 31st Annual Meeting, November 7-11, Portland, OR, USA.

(27) Lencina-Avila, J. M.; Cavicchioli-Azevedo, V.; Rodrigues, S.C.; Lopes, T.M.; Klein, R.D.; Paganini, C.L.; Barcarolli, I.F.; Chaves, I.S.; Bianchini, A. 2010. Análise de biomarcadores e metais acumulados na corvina, *Micropogonias furnieri* (Desmarest, 1823), do estuário da lagoa dos patos (RS). XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(28) Leonard, E.M.; Barcarolli, I.F.; Wasielesky, W.; Wood, C.M.; Bianchini, A. 2010. Evaluating the effects of salinity on chronic Ni toxicity, bioaccumulation and behaviour in two euryhaline crustaceans: *L. vannamei and E. armata*. North America 31st Annual Meeting, November 7-11, Portland, OR, USA.

(29) Machado, A.A.S.; Araujo, R.G.; Teixeira, P.; Garcia, V.M.T.; Bianchini, A. 2010. Efeitos do zinco sobre o crescimento de *Thalassiosira weissflogii*. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(30) Machado, A.A.S.; Avila, T.R.; Bianchini, A. 2010. Effects of metals on chitobiase activity: Relevance in ecological and ecotoxicological studies. North America 31st Annual Meeting, November 7-11, Portland, OR, USA.

(31) Machado, A.A.S.; Ávila, T.R.; Bianchini, A. 2010. Toxicidade de metais no desenvolvimento naupliar e atividade da quitobiase do copépode *Acartia tonsa*. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(32) Martins, C., Menezes, E.J., Giacomin, M.M., Wood, C.M., Bianchini, A. 2010. Toxicity and tissue distribution and accumulation of copper in the blue crab Callinectes sapidus acclimated to different salinities. North America 31st Annual Meeting, November 7-11, Portland, OR, USA.

(33) Menezes, E.J.; Martins, C.; Bianchini, A. 2010. Acumulação e toxicidade do cobre no siri-azul *Callinectes sapidus.* 9ª Mostra da Produção Universitária (MPU), Universidade Federal do Rio Grande, October 19-22, Rio Grande, RS, Brazil.

(34) Narcizo, A.M.; Correia, T.G.; Bianchini, A.; Mayer, M.G.; Floeter-Winter, L.M.; Moreira, M.G. 2010. Efeitos da exposição aguda ao alumínio e variações do pH na expressão de gonadotropinas de *Oreochromis niloticus*. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(35) Nogueira, L.S.; Oliveira, C.B.; Bianchini, A. 2009. Mechanisms of copper accumulation in isolated gill cells of the clam *Mesodesma mactroides*. SETAC North America 30th Annual Meeting, November 17-23, New Orleans, LA, USA.

(36) Oliveira, C.; Lauer, M.M.; Bianchini, A. 2010. Toxicidade do cobre em larvas do ouriço-do-mar *Echinometra lucunter*. 9ª Mostra da Produção Universitária (MPU), Universidade Federal do Rio Grande, October 19-22, Rio Grande, RS, Brazil.

(37) Prazeres, M.F.; Martins, S.E.; Bianchini, A. 2010. Utilização do foraminífero com endossimbionte *Amphistegina lessonii* como bioindicador da qualidade de água do Arquipélago de Fernando de Noronha. IV Congresso Brasileiro de Oceanografia, May 17-21, Rio Grande, RS, Brazil.

(38) Smith, D.S., Diao, L., Wood, C.M. 2010. Copper interactions with isolated gill cells and with gill cell inserts: testing of Biotic Ligand Model parameters. 31st Annual Meeting SETAC, Portland, US. Nov 2010.

(39) Velasques, R. R.; Simas, M. M.; Alvez, M. L.; Capellari, N.; Bianchini, A.; Martins, S.E. 2010. Utilização de organismos marinhos como ferramenta para avaliação da saúde de ambientes costeiros do extremo sul do Brasil. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(40) Wood, C.M. 2010. A brief history of metals: regulation and toxicity of metals in aquatic ecosystems. Annual Meeting, Society of Experimental Biology, June 30-July 3, Prague, Czech Republic.

(41) Wood, C.M. 2010. Teleost fish- the pro's and con's of living with high ammonia. New Frontiers Lecture, University of Toronto -Scarborough, September 16, Toronto, Canada.

(42) Wood, C.M.; Zimmer, A. M.; Zhang, L.; Jonz, M.; Nurse, C.A.; O'Donnell, M.J.; Nawata, C.M. 2010. Ammonia excretion in high ammonia environments. 9th International Congress on the Biology of Fish, July 5-9, Barcelona, Spain.

(43) Abou Anni, I.S., Robaldo, R.B., Bianchini, A., Barcarolli, I.F., Tesser, M. Almeida, D.V., Martins, C.M.G., Figueiredo, M.D.A., Lanes, C.F.C., Bianchini, A., Marins, L.F.F. 2011. Effects of growth hormone transgenesis on osmoregulation and energy metabolism in zebrafish (*Danio rerio*). XXVI Reunião Anual da Federação de Sociedades de Biologia Experimental - FeSBE, August 24-27, Rio de Janeiro, RJ, Brazil.

(44) Avila, T.R., Machado, A.A.S., Bianchini, A. 2011. Estimative of secondary production in Patos Lagoon Estuary (Brazil, RS): methodological aspects. 5th International Zooplankton Production Symposium – Population Connections, Community Dynamics, and Climate Variability, March 14-18, Pucon, Chile.

(45) Bianchini, A. 2011. Avaliação e monitoramento da qualidade de águas costeiras e marinhas no Brasil: Biomarcadores de poluentes químicos. 3º Congresso Brasileiro de Biologia Marinha, May 15-19, Natal, RN, Brazil.

(46) Bianchini, A. 2011. Biomarcadores de contaminantes químicos em animais aquáticos. Pontifícia Universidade Católica do Rio Grande do Sul – PUCRS, September 13, Porto Alegre, RS, Brazil.

(47) Bianchini, A. 2011. Biomarcadores de exposição e efeito de poluentes aquáticos em animais estuarinos e marinhos. IV Workshop e I Simpósio de Ecotoxicologia. UNESP, October 10-12, Rio Claro, SP, Brazil.

(48) Bianchini, A. 2011. Diferentes concentrações hormonais e de organoclorados nos diferentes estágios da vida dos elefantes marinhos do sul – Antártica. XXIX Semana Acadêmica da Medicina Veterinária, Universidade Federal de Pelotas – UFPEL, October 24-28, Pelotas, RS, Brazil.

(49) Bianchini, A. 2011. Identificação e aplicação de biomarcadores de contaminantes químicos em animais estuarinos e marinhos. XXIII Semana Nacional de Oceanografia, August 10, São Luiz, MA, Brazil.

(50) Bianchini, A. 2011. Políticas e ações para melhoria da Iniciação Científica e Tecnológica. I Fórum Institucional sobre Pesquisa e Desenvolvimento Científico na FURG. Universidade Federal do Rio Grande – FURG, August 5, Rio Grande, RS, Brazil.

(51) Bianchini, A. 2011. Poluição em ambientes costeiros: Monitoramento biológico. IV Semana Acadêmica de Oceanologia. Universidade Federal do Rio Grande – FURG, September 16, Rio Grande, RS, Brazil.

(52) Bianchini, A. 2011. Toxicologia ambiental e suas aplicações. Semana Acadêmica de Toxicologia Ambiental, Universidade Federal do Rio Grande – FURG, August 17-19, Rio Grande, RS, Brazil.

(53) Bianchini, A. 2011. Uso de ferramentas biológicas na avaliação e monitoramento da qualidade de águas costeiras do Brasil: situação atual e perspectivas. 3º Congresso Brasileiro de Biologia Marinha, May 15-19, Natal, RN, Brazil.

(54) Bolzan, C.M., Martins, G.A., Menezes, E.J., Caldas, S.S., Dias, A.N., Martins, C.M.G., Bianchini, A., Primel, E.G. 2011. Estudo de método para extração de agrotóxicos em hepatopâncreas de siri por MSPD e determinação por CG-IE-EM. Sociedade Brasileira de Química, July 26, Florianópolis, SC, Brazil.

(55) Cardozo, J.G., Machado, A.A.S., Hoff, M.L.M., Bianchini, A. 2011. Análise de micronúcleo em *Poecillia vivípara* exposto ao cobre. XVII Congresso Brasileiro de Toxicologia. June 22-25, Ribeirão Preto, SP, Brazil.

(56) Cunha, V.C., Barcarolli, I.F., Sampaio, L.A., Bianchini, A. 2011. Dietary salt supplementation for juvenile mullet *Mugil platanus* reared in freshwater. World Aquaculture Society, January, Natal, RN, Brazil.

(57) Cunha, V.C., Barcarolli, I.F., Sampaio, L.A., Bianchini, A. 2011. The effects of salinity on growth of juvenile mullet *Mugil platanus*. World Aquaculture Society, January, Natal, RN, Brazil.

(58) Diamond, R.L., Tellis, M., Wood, C.M., Smith, D.S. 2011. Fluorescence quenching method to determine copper, lead, zinc and nickel binding to organic matter in saltwater. Canadian Society of Chemistry, June 2011. Montreal, Quebec.

(59) Furci, B.B., Avila, T.R., Bianchini, A. 2011. Toxicidade aguda do zinco no copépode estuarino *Acartia tonsa*. 10ª Mostra da Produção Universitária – MPU, FURG, October 24-28, Rio Grande, RS, Brazil.

(60) Gomes E.G., Machado A.A.S., Hoff M.L.M., Bianchini A. 2011. Lipoperoxidação induzida pela exposição à atrazina, fenantreno e cobre em *Poecillia vivípara*. 10ª Mostra da Produção Universitária – MPU, FURG, October 24-28, Rio Grande, RS, Brazil.

(61) Gomes, E.G., Machado, A.A.S., Hoff, M.L.M., Bianchini, A. 2011. Avaliação da lipoperoxidação em peixe como potencial biomarcador de contaminação aquática. IV Workshop e I Simpósio de Ecotoxicologia. UNESP, October 10-12, Rio Claro, SP, Brazil.

(62) Gomes, E.G., Machado, A.A.S., Hoff, M.L.M., Bianchini, A. 2011. Lipoperoxidação como biomarcador de exposição ao cobre em *Poecillia vivípara*. XVII Congresso Brasileiro de Toxicologia. June 22-25, Ribeirão Preto, SP, Brazil.

(63) Jorge, M.B., Bianchini, A., Wood, C.M. 2011. Copper toxicity to glochidia larvae (*Lampsilis cardium*): accumulation and effects. 20th Annual Comparative Physiology and Biochemistry Workshop, Elmhirst's Resort, Keene, Ontario, February 4-6, 2011.

(64) Klein, R.D., Rosa, C.E., Sandrini, J.Z., Colares, E.P., Robaldo, R.B., Martinez, P.E., Bianchini, A. 2011. Oxidative damage in response to heat stress in the Antarctic fish *Notothenia coriiceps.* IV Workshop e I Simpósio de Ecotoxicologia. UNESP, October 10-12, Rio Claro, SP, Brazil.

(65) Martins, C.D.M.G., Menezes, E.J.D., Giacomin, M.M., Bianchini, A. 2011. Acute toxicity and accumulation of copper in the blue crab *Callinectes sapidus* acclimated to different salinities. XXVI Reunião Anual da Federação de Sociedades de Biologia Experimental - FeSBE, August 24-27, Rio de Janeiro, RJ, Brazil.

(66) Martins, S.E., Bianchini, A. 2011. Utilização de testes de toxicidade para a proteção de comunidades aquáticas costeiras no Brasil. XVII Congresso Brasileiro de Toxicologia. June 22-25, Ribeirão Preto, SP, Brazil.

(67) Menezes, E.J., Barcarolli, I., Martins, C., Bianchini, A. 2011. Avaliação da acetilcolinesterase (AChE) como biomarcador de contaminação por organofosforados na Lagoa dos Patos – RS. 10ª Mostra da Produção Universitária – MPU, FURG, October 24-28, Rio Grande, RS, Brazil.

(68) Nawata, C.M., Walsh, P.J., Wood, C.M. 2011. How the dogfish shark copes with high environmental ammonia. 8th International Congress of Comparative Physiology and Biochemistry. May 31st-June 5th, Nagoya, Japan.

(69) Nogueira, L.S., Wood, C.M., Bianchini, A., Gillis, P.L. 2011. Mechanisms of sodium extrusion in isolated mitochondria-rich cells of the freshwater mussel *Lasmigona costata* after copper exposure. IV Workshop & I Simpósio de Ecotoxicologia. UNESP, October 10-12, Rio Claro, SP, Brazil.

(70) Nogueira, L., Bianchini, A., Wood, C.M. 2011. Physiological effects of high NaCl exposure on the freshwater larvae L. fasciola. 20th Annual Comparative Physiology and Biochemistry Workshop, Elmhirst's Resort, Keene, Ontario, February 4-6, 2011.

(71) Silva, C.C., Varela Júnior, A.S., Barcarolli, I.F., Bianchini, A. 2011. Padrões de distribuição e concentração de metais em tecidos de tartarugas-verdes (*Chelonia mydas*) oriundas de encalhes na costa sul do RS. 3º Congresso Brasileiro de Biologia Marinha, May 15-19, Natal, RN, Brazil.

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(143) Silva, C.C.; Bianchini, A. 2012. Hemograma e bioquímica sanguínea de tartarugas-verdes (*Chelonia mydas*) com e sem fibropapilomatose. V Congresso Brasileiro de Oceanografia. November 13-16, Rio de Janeiro, RJ, Brazil.

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(153) Zimmer, A.; Barcarolli, I.F.; Wood, C.M.; Bianchini, A. 2012. Mechanisms of copper-induced inhibition of ammonia excretion and sodium uptake in fish. SEB Annual Main Meeting, July 1st, Salzburg, Austria.

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(161) Bianchini, A. 2013. Effects of waterborne copper and its possible mode of toxic action in marine invertebrates. SETAC North America 34th Annual Meeting, November 17-21, Nashville, TN, USA.

(162) Bianchini, A. 2013. Resposta de organismos recifais à poluição. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

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(164) Blewett, T.; Niyogi, S.; Fehsenfeld, S.; Wood, C.M. 2013. Making sense of nickel toxicity in saline waters: nickel accumulation in the estuarine crab, *Carcinus maenas.* 52nd Annual Meeting, Canadian Society of Zoologists, Guelph, Ontario. May, 2013.

(165) Calderon, E.N.; Duarte, G.; Peixoto, R.S.; Santos, H.F.; Marangoni, L.F.B.; Marques, J.A.; Bianchini, A.; Zilberberg, C.; Chaloub, R.; Castro, C.B. 2013. Susceptibilidade de hidrocorais a anomalias térmicas: diferenças intra- e interespecíficas. 4º Congresso Brasileiro de Biologia Marinha. May 19-23, Florianópolis, SC, Brazil.

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(171) Fonseca, J.S.; Jorge, M.B.; Bianchini, A. 2013. Avaliação da Frequência de Células Micronucleadas (FCM) como biomarcador de exposição no peixe estuarino *Poecilia vivipara*. XVIII Congresso Brasileiro de Toxicologia, October 7-10, Porto Alegre, RS, Brazil.

(172) Freitas, C.S.; Abou Anni, I.S.; Bianchini, A.; Silva, E.F.; Cardoso, T.F.; Silva, J.C.; Corcini, C.D.; Varela Jr.; A.S. 2013. Efeito da exposição crônica ao cobre sobre a integridade do DNA em espermatozóides de *Poecilia vivipara.* 13ª Mostra da Produção Universitária, October 14-17, Rio Grande, RS, Brazil.

(173) Furci, B.B.; Ávila, T.R.; Bianchini, A. 2013. Influência da matéria orgânica dissolvida na acumulação de zinco no copépode estuarino *Acartia Tonsa*. 12ª Mostra da Produção Universitária, October 23-25, Rio Grande, RS, Brazil.

(174) Giacomin, M.M.; Gillis, P.L.; Bianchini, A.; Wood, C.M. 2013. Interactive effects of copper and dissolved

organic matter on juvenile freshwater mussel physiology. SETAC North America 34th Annual Meeting, November 17-21, Nashville, TN, USA.

(175) Giacomin, M.M.; Jorge, M.B.; Bianchini, A. 2013. Effects of copper exposure on energy metabolism in the yellow clam *Mesodesma mactroides*. SETAC North America 34th Annual Meeting, November 17-21, Nashville, TN, USA.

(176) Goulart, J.; Barcarolli, I.; Bianchini, A. 2013. Atividade da acetilcolinesterase na corvina *Micropogonias furnieri* de áreas poluídas do Saco da Mangueira. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

(177) Jorge, M.B.; Bianchini, A. 2013. Ionoregulatory and respiratory disturbances induced by copper in the osmoconforming clam *Mesodesma mactroides*. SETAC North America 34th Annual Meeting, November 17-21, Nashville, TN, USA.

(178) Jorge, M.B.; Bianchini, A. 2013. Redox parameters in the marine clam *Mesodesma mactroides* acutely exposed to copper. SETAC North America 34th Annual Meeting, November 17-21, Nashville, TN, USA.

(179) Marangoni, L.F.B.; Marques; J.A.; Duarte, G.A.S.; Pereira, C.M.; Calderon, E.N.; Castro, C.B.; Bianchini, A. 2013. Efeito do cobre e da temperatura sobre a performance fotossintética máxima do fotossistema II no coral *Mussismilia harttii.* 4º Congresso Brasileiro de Biologia Marinha. May 19-23, Florianópolis, SC, Brazil.

(180) Marques, J.A.; Marangoni, L.F.B.; Bianchini, A. 2013. Efeito da salinidade e da exposição ao cobre no foraminífero *Amphistegina spp*. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

(181) Marques, J.A.; Marangoni, L.F.B.; Bianchini, A. 2013. Uso de biomarcadores em organismos recifais para avaliação de impactos locais e mudanças climáticas. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

(182) Martins, S.E.G.; Bianchini, A. 2013. Copper accumulation and toxicity in the yellow clam *Mesodesma mactroides* Desahyes 1854 (Bivalvia, Mesodesmatidae). I Congresso Internacional de Ecotoxicologia Marinha, June, 17-21, Recife, PE, Brazil.

(183) Ojoo, R.O.; Kisipan, M.L.; De Boeck, G.; Wood, C.M.; Bianchini, A.; Maina, J.; Johannsson, O.E.; Brix, K.; Otiang'a-Owitis, G.; Bianchini, L.; Kavembe, D.G.; Bergman, H.L.; Papah, M.B. 2013. The Magadi Tilapia (*Alcolapia grahami*): a fish thriving in extreme adversity. Soda Lakes Workshop. December 4-6, Naivasha, Kenya.

(184) Papah, M.B.; Kisia, S.M.; Ojoo, R.O.; Wood, C.M.; Kavembe, G.D.; Maina, J.; Johannsson, O.E.; De Boeck, G.; Bianchini, A.; Brix, K.; Letura, K.M.; Bianchini, L.F.; Onyango, D.W. 2013. Lake Magadi ecosystem: Current research trends and future perspectives. International . One Health Conference, September 23-26, Addis Ababa, Ethiopia.

(185) Papah, M.B.; Wood, C.M.; Kavembe, G.D.; Maina, J.; Johannsson, O.E.; De Boeck, D.; Bianchini, A.; Brix, K.; Letura, K.M.; Bergman, H.L.; Bianchini, L.F.; Ojoo, R.O. 2013. Spermiogenesis and sperm ultrastructure in Lake Magadi tilapia (*Alcolapia grahami*) and their possible phylogenetic significance. Soda Lakes Workshop. December 4-6, Naivasha, Kenya.

(186) Righi, B.D.P.; Abujamara, L.D.; Barcarolli, I.; Bianchini, A. 2013. Biomarcadores em siris *Callinectes spp.* para monitoramento da contaminação em estuários do Maranhão. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

(187) Righi, B.D.P.; Bianchini, A. 2013. Biomarcadores em siris *Callinectes spp.* para monitoramento da contaminação em estarios do Maranhão. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

(188) Santos, H.F.; Carmo, F.L.; Duarte, G.; Calderon, E.; Marangoni, L.; Bianchini, A.; Chaloub, R.; Pires, D.; Castro, C.; Rosado, A.S.; Peixoto, R.S.. 2013. Biorremediação de ambiente recifal contaminado por óleo. 4º Congresso Brasileiro de Biologia Marinha. May 19-23, Florianópolis, SC, Brazil.

(189) Silva, C.C.; Bianchini, A. 2013. Parâmetros sanguíneos e concentração de metais em tartarugas-verdes (*Chelonia mydas*) sem e com fibropapilomatose. VI and VII Sea Turtle Conservation and Research Meeting in the South Western Atlantic (ASO). November 5-8, Piriapolis, Maldonado, Uruguay.

(190) Simonato, J.D.; Fernandes, M.N.; Bianchini, A.; Martinez, C.B.R. 2013. Comet assay in fish erythrocytes for freshwater monitoring in areas contaminated with phenantrene, atrazine and copper. SETAC Europe 23rd Annual Meeting, May 12-16, Glasgow, UK.

(191) Simonato, J.D.; Fernandes, M.N.; Bianchini, A.; Martinez, C.B.R. 2013. Biochemical biomarkers for freshwater monitoring in areas contaminated with phenantrene, atrazine and copper. SETAC Europe 23rd Annual Meeting, May 12-16, Glasgow, UK.

(192) Tavares, F.V.; Monteiro, S.C.R.; Martins, C.M.G.; Bianchini, A. 2013. Gerenciamento de resíduos no Instituto de Ciências Biológicas (ICB) da FURG: alternativas para minimização, neutralização e degradação de compostos químicos. 12ª Mostra da Produção Universitária, October 23-25, Rio Grande, RS, Brazil.

(193) Tellis, M.S.; Lauer, M.M.; Nadella, S.; Bianchini, A.; Wood, C.M. 2013. Sublethal mechanisms of Pb, Zn, Cu and Ni toxicity to the purple sea urchin (*Strongylocentrotus purpuratus*) during early development. Congresso Brasileiro de Toxicologia Aquática. Nov. 4-8, Rio Grande, RS, Brazil.

(194) Wood, C.M. 2013. Regulation and toxicity of metals in aquatic ecosystems. Keynote address. Congresso Brasileiro de Toxicologia Aquatica. Rio Grande, Brazil. November 2013

(195) Afonso, S.; Abou Anni, I.S.; Moreno, I.; Lauer, M.M.; Bianchini, A. 2014. Efeito da exposição crônica ao cobre no crescimento do teleósteo eurialino *Poecilia vivipara.* 13ª Mostra da Produção Universitária, October 14-17, Rio Grande, RS, Brazil.

(196) Barcarolli, I.F.; Miranda, D.M.; Cardozo, J.G.; Bianchini, A. 2014. Biomarkers as an alternative tool for evaluation and monitoring the quality of coastal waters in southern Brazil. 23rd Annual Comparative Physiology and Biochemistry Workshop, January 31-February 1-2, Elmhirst's Resort, Keene, ON, Canada.

(197) Bianchini, A. 2014. Carbonic anhydrase as a biomarker of copper exposure in marine organisms. SETAC North America 35th Annual Meeting, November 9-13, Vancouver, BC, Canada.

(197) Bianchini, A. 2014. Painel com os egressos da Fisiologia. Fisiologia 60 anos de pesquisa. IV Simpósio

de Atualização em Fisiologia do Sistema Nervoso. IV Mostra de Projetos em Fisiologia. November 6-7, Porto Alegre, RS, Brazil.

(198) Bianchini, L.F.; Wood, C.M.; Bergman, H.L.; Laurent, P.; Maina, J.; Johannsson, O.E.; Chevalier, C.; Kavembe, G.D.; Papah, M.B.; Ojoo, R.O.; Bianchini, A. 2014. Diurnal variations in oxidative stress parameters in the larvae of the chironomidae *Tanytarsus minutipalpus* from Lake Magadi (Kenya, Africa)**.** 23rd Annual Comparative Physiology and Biochemistry Workshop, January 31-February 1-2, Elmhirst's Resort, Keene, ON, Canada.

(199) Blewett, T.; Glover, C.; Niyogi, S.; Wood, C.M. 2014. Epithelial transport of trace metals in Pacific hagfish. International Congress on the Biology of Fish, August 3-7, Edinburgh, Scotland, the United Kingdom.

(200) Blewett, T.; Ransberry, V.; McClelland, G.; Wood, C.M. 2014. The effect of salinity on the mechanisms of Ni toxicity in the euryhaline Atlantic killifish. International Congress on the Biology of Fish, August 3-7, Edinburgh, Scotland, the United Kingdom.

(201) Blewett, T.A.; Smith, S.; Wood, C.M.; Glover, C.N. 2014. Ni effects on the development of the New Zealand sea urchin *Evechinus chloroticus*. Society of Environmental Toxicology and Chemistry, Vancouver, B.C., Canada Nov. 11, 2014.

(202) Blewett, T.A.; Wood, C.M.; Glover, C. 2014. What's up DOC? Protective effects of dissolved organic carbon against nickel toxicity to sea urchin early life-stages. Canadian Society of Zoologists Annual Meeting, May 25th-29th, Montreal, Quebec

(203) Blewett, T.A.; Wood, C.M.; Smith, S.; Glover, C. 2014. Developmental toxicity of Ni to the New Zealand sea urchin (*Evechinus chloroticus*) . 3rd Aquatic Toxicology Symposium,. June 10th-12th, Fort Worden, WA, U.S.A.

(204) Cardozo, J.G.; Miranda, D.M.; Barcarolli, I.F.; Bianchini, A. 2014. Atividade acetilcolinesterásica no cérebro e músculo da corvina *Micropogonias furnieri* como biomarcador da exposição a metais no estuário da Lagoa dos Patos (Rio Grande, RS).13ª Mostra da Produção Universitária, October 14-17, Rio Grande, RS, Brazil.

(205) Fonseca, J.S.; Marangoni, L.F.B.; Marques, J.A.; Bianchini, A. 2014. Biomarcadores de calcificação no coral *Mussismilia harttii* exposto ao cobre. 13ª Mostra da Produção Universitária, October 14-17, Rio Grande, RS, Brazil.

(206) Furci, B.B.; Bianchini, A. 2014. Avaliação das variações sazonal e espacial de biomarcadores bioquímicos em *Acartia tonsa* no estuário da Lagoa dos Patos (RS). 13ª Mostra da Produção Universitária, October 14-17, Rio Grande, RS, Brazil.

(207) Giacomin,M.; Schulte, P.; Wood, C.M. 2014. The effects of hypoxia on branchial ion exchange in freshwater acclimated killifish (*Fundulus heteroclitus*). Canadian Society of Zoologists Annual Meeting, May 25th-29th, Montreal, Quebec.

(208) Gillis, P.; Machado, A.A.D.S.; de Solla, S.; Bianchini, A.; Wood, C.M. 2014. Examining the contribution of metal exposure to observed negative impacts in wild freshwater mussels. 3rd Aquatic Toxicology Symposium. June 10th-12th, Fort Worden, WA, U.S.A.

(209) Johannsson, O.E.; Wood, C.M.; Bergman, H.; Laurent, P.; Kavembe, G.D.; Bianchini, A.; Bianchini, L.; Maina, J.; Chevalier, C.; Papah, M.; Brix, K.; DeBcoek, G.; Letura, K. Ojoo, R. 2014. Air breathing in the Lake Magaditilapia, *Alcolapiagrahami*–hypoxic and oxicbehaviours: the role of ROS? Canadian Society of Zoologists, 53rd Annual Meeting, May, 25-29, Montreal, QC, Canada.

(210) Marangoni, L.F.B.; Marques, J.A.; Duarte, G.A.S.; Pereira, C.M.; Calderon, E.N.; Castro, C.B.; Bianchini, A. 2014. Biomarcadores para avaliação dos efeitos do cobre no coral *Mussismilia harttii* (Cnidaria, Scleractinia, Mussidae). XIII Congresso Brasileiro de Ecotoxicologia, September 23-26, Guarapari, ES, Brazil.

(211) Marangoni, L.F.B.; Marques, J.A.; Duarte, G.A.S.; Pereira, C.M.; Calderon, E.N.; Castro, C.B.; Bianchini, A. 2014. Biomarkers responses in the Brazilian coral *Mussismilia harttii* (Cnidaria, Scleractinia, Mussidae) after waterborne copper exposure. SETAC North America 35th Annual Meeting, November 9-13, Vancouver, BC, Canada.

(212) Marques, D.M.; Barcarolli, I.F.; Bianchini, A. 2014. The BLM as an alternative tool for evaluation and monitoring the quality of coastal waters in southern Brazil. 23rd Annual Comparative Physiology and Biochemistry Workshop, January 31-February 1-2, Elmhirst's Resort, Keene, ON, Canada.

(213) Marques, J.A.; Marangoni, L.F.B.; Bianchini, A. 2014. Biomarkers responses to copper exposure and ocean acidification in *Amphistegina* spp. (Amphisteginidae, Foraminifera). SETAC North America 35th Annual Meeting, November 9-13, Vancouver, BC, Canada.

(214) Marques, J.A.; Marangoni, L.F.B.; Bianchini, A. 2014. Respostas de biomarcadores associados à calcificação em *Amphistegina* spp. (Amphisteginidae, Foraminifera) a exposição ao cobre e a acidificação marinha. XIII Congresso Brasileiro de Ecotoxicologia, September 23-26, Guarapari, ES, Brazil.

(215) Niyogi, S.; Blewett, T.A.; Wood, C.M. 2014. Effects of salinity on short-term zinc uptake, accumulation, and sub-lethal toxicity in European green crab (*Carcinus maenas*). Society of Environmental Toxicology and Chemistry, Vancouver, B.C., Canada Nov. 11, 2014

(216) Torreiro-Melo, A.G.A.G.; Scanoni, J.; Bianchini, A.; Lamardo, E.Z.; Carvalho, P.S.M. 2014. Bioconcentration of phenanthrene metabolites in bile and behavioral alterations in the tropical estuarine guppy Poecilia vivipara. XIII Congresso Brasileiro de Ecotoxicologia, September 23-26, Guarapari, ES, Brazil.

(217) Wood, C.M. 2014. Workshop summary and recommendations: NiPERA Meeting on Mechanisms of Ni Toxicity to Aquatic Organisms., Metals Advisory Group Meeting, Society of Environmental Toxicology and Chemistry, Vancouver, B.C., Canada Nov. 11-14, 2014.

(218) Wood, C.M. 2014. Overview of Ni toxicity mechanisms for aquatic organisms. Keynote Address. NiPERA Meeting on Mechanisms of Ni Toxicity to Aquatic Organisms. Vancouver, B.C., Canada. Nov. 9, 2014.

(219) Wood, C.M. 2014. Perspectives on graduate supervision in the health and environmental sciences. Post-Graduate Symposium on Tropical Medicine., Universidade do Estado do Amazonas, Manaus, AM, Brazil. Nov. 26-27, 2014.

(220) Wood, C.M. 2014. Some thoughts on the OIST marine lab (with examples from sea urchins and

sharks). Workshop: Opportunities for Marine Science, Okinawa Institute for Science and Technology, Oct. 29-30, 2014.

(221) Wood, C.M. 2014. The importance of physiology in metals toxicology. Keynote address. 3rd Aquatic Toxicology Symposium. June 10th-12th, Fort Worden, WA, U.S.A.

(222) Wood, C.M.; Nogueira, L.; Nadella, S.R.; Loro, V.L. 2014. Toxicity, bioaccumulation and ionoregulatory impacts in *Fundulus heteroclitus* exposed to waterborne zinc at different salinities. Society of Environmental Toxicology and Chemistry, Vancouver, B.C., Canada Nov. 11, 2014.

iv. Presentation (non-academic)

(1) Bianchini, A. 2012. Toxicologia e Meio Ambiente. I Simpósio de Integração das Pós-Graduações do Centro de Ciências Biológicas da UFSC, August 12-16, Florianópolis, SC, Brazil.

(2) Bianchini, A. 2012. Instituto Nacional de Ciência e Tecnologia de Toxicologia Aquática. CENPES, Petrobras, November 29, Rio de Janeiro, RJ, Brazil.

(3) Bianchini, A. 2013. Meio Ambiente: desenvolvimento humano e desafios para a conservação. Semana do Meio Ambiente "Rua Verde". June 3-8, Rio Grande, RS, Brazil.

(4) Bianchini, A. 2014. Evolução da produção do conhecimento em fisiologia na região sul do RS. I Simpósio de Fisiologia da Região Sul. September 25-26, Pelotas, RS, Brazil.

(5) Bianchini, A. 2014. Instituto de Ciências Biológicas. II Fórum Institucional de Pesquisa, Desenvolvimento e Inovação Tecnológica. June 10, Rio Grande, RS, Brazil.

v. Book Chapters

(1) Bianchini, A. 2009. Vida na Antártica. In: Machado, M.C.S.; Brito, T. (Eds.). Antártica: Ensino Fundamental e Médio. 1ª ed., Brasília - DF: Ministério da Educação, Secretaria da Educação Básica, v. 9, p. 67-92.

(2) Bianchini, A.; Robaldo, R. B.; Sampaio, L.A.N. 2010. Cultivo do linguado (*Paralichthys orbignyanus*). In: Baldisserotto, B.; Gomes, L.C.. (Org.). Espécies Nativas para a Piscicultura no Brasil. 2ª Edição Revisada e Ampliada. Santa Maria - RS: Editora UFSM, v. 1, p. 1-30.

(3) Wood, C.M. 2012. An introduction to metals in fish physiology and toxicology: Basic principles. Pp. 1-51. In Fish Physiology, Vol 31A: Homeostasis and Toxicology of Essential Metals. (C.M. Wood, A.P. Farrell and C.J. Brauner, editors) Academic Press, San Diego.

(4) Wood, C.M. 2012. Silver. In: Metals: Homeostasis and Toxicology: Non-essential Metals. Fish Physiology, Vol. 31B. Edited by C.M. Wood, A.P. Farrell, and C.A. Brauner. Academic Press, San Diego. pp. 1-65.

vi. Books

(1) Wood, C.M.; Farrell, A.P.; Brauner, C.J. 2012. Homeostasis and Toxicology of Essential Metals. Fish Physiology Vol. 31A, Academic Press, San Diego. 497 p.

(2) Wood, C.M.; Farrell, A.P.; Brauner, C.J. 2012. Homeostasis and Toxicology of Non-essential Metals. Fish Physiology Vol. 31B, Academic Press, San Diego. 507 p.

vii. Theses

MSc Thesis

(1) Lygia Sega Nogueira. 2009. Mecanismo de transporte e acumulação do cobre em células branquiais do marisco *Mesodesma mactroides*. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(2) Marianna Basso Jorge. 2009. Influência da matéria orgânica dissolvida na acumulação e toxicidade aguda do cobre no marisco *Mesodesma mactroides*. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(3) Cinthia Carneiro da Silva. 2010. Padrões de distribuição e concentração de metais em tecidos de tartarugas verdes (*Chelonia mydas*) oriundas de encalhes na costa sul do Rio Grande do Sul. 2010. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(4) Rafael Godoy Petry. 2010. Expressão do RNAm de proteínas envolvidas na resposta ao choque térmico em eritrócitos e fígado de peixes antárticos (*Notothenia coriiceps* e *Notothenia rossii*). MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(5) Roberta Daniele Klein. 2010. Ausência de indução da expressão das proteínas de choque térmico (Hsp70)em eritrócitos do peixe antártico *Notothenia coriiceps*. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(6) Alex M. Zimmer. 2011 Quantifying the relative roles of branchial and cutaneous ammonia excretion in freshwater rainbow trout: A physiological and molecular approach. M.Sc.--> Ph,D. transfer thesis, Dept. of Biology, McMaster University, Hamilton, Canada. Supervisor: Chris M. Wood.

(7) Josias S. Grobler. 2011. Investigations into the formation of rainbow trout (*Oncorhynchus mykiss*) social hierarchies and possible hierarchical disruption by an environmental perturbation. M.Sc. thesis, Dept. of Biology, McMaster University, Hamilton, Canada. Supervisor: Chris M. Wood.

(8) Martina de Freitas Prazeres. 2011. Biomarcadores de exposição ao zinco em *Amphistegina lessonii* (Amphisteginidae, Foraminifera) do Arquipélago de Fernando de Noronha, PE, Brasil. MSc Thesis, Universidade Federal do Rio Grande. Supervisor:: Adalto Bianchini.

(9) Tamzin A. Blewett. 2011. Environmental influences on the accumulation of ethynylestradiol in marine teleosts. M.Sc. thesis, Dept. of Biology, McMaster University, Hamilton, Canada. Supervisor: Chris M. Wood

(10) Anderson Abel de Souza Machado. 2012. Biomarcadores de contaminação aquática no peixe Poecilia vivipara. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(11) Laís Donini Abujamara. 2012. Efeitos da pré-exposição ao cobre sobre respostas bioquímicas da anêmona-do-mar *Bunodosoma cangicum* a hipóxia e reoxigenação. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(12) Margareth S. Tellis. 2012. The effect of Pb, Zn, Cu, and Ni on the embryonic and larval stages of *Strongylocentrotus purpuratus*. M.Sc. thesis, Dept. of Biology, McMaster University, Hamilton, Canada. Supervisor: Chris M. Wood.

(13) Michele da Silva Aires. 2012. Efeitos bioquímicos e fisiológicos da exposição ao níquel no caranguejo eurialino *Neohelice granulata*. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(14) Paloma Calábria Carvalho. 2012. Concentração de metais no sangue e em penas de petréis do gênero *Procellaria*. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(15) Cyntia Ayumi Yokota Harayashiki. 2013. Efeitos tóxicos do herbicida Roundup no peixe Poecilia vivipara (Bloch e Schneider, 1801). MSc Thesis, Universidade Federal do Rio Grande. Co-supervisor:: Adalto Bianchini.

(16) Cindy Tavares Barreto. 2013. Aves aquáticas como indicadores de contaminação por metais em áreas úmidas no sul do Brasil. MSc Thesis, Universidade Federal do Rio Grande. Co-supervisor: Adalto Bianchini.

(17) Evelise Sampaio da Silva. 2013. Caracterização transcricional dos transportadores de cobre CTR1 e ATP7B no peixe *Poecilia vivipara*: influência do cobre e da salinidade. MSc Thesis, Universidade Federal do Rio Grande. Supervisor. Orientador: Adalto Bianchini.

(18) Lisa Robertson. 2013. A survey of ionoregulatory responses to extended exercise and acute hypoxia in freshwater Amazonian and Southern Ontarian teleosts: Investigating the osmorespiratory compromise. M.Sc. thesis, Dept. of Biology, McMaster University, Hamilton, Canada. Supervisor: Chris M. Wood.

(19) Marina Mussoi Giacomin. 2013. Efeitos do cobre no metabolismo energético do bivalve marinho *Mesodesma mactroides*. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(20) Victoria Rainsberry. 2013. Oxidative stress and metabolic responses of acute water-borne copper exposure in killifish. M.Sc.thesis, Dept. of Biology, McMaster University, Hamilton, Canada. Supervisor: Grant McClelland.

(21) Vinícius Dias Borges. 2013. Parâmetros do metabolismo oxidativo na anêmona-do-mar *Bunodosoma cangicum*: variação sazonal e efeito da exposição ao ar. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(22) Arthur Juan Costa Mathias. 2014. Biomarcadores em *Poecilia vivipara* (Cyprinodontiformes, Poeciliidae) expostoa ambiente salino com histórico de contaminação por metais. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(23) Bruna Duarte Pereira Righi. 2014. Biomarcadores de contaminação ambiental no siri *Callinectes spp*. de estuários do Maranhão. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(24) Joseane Aparecida Marques. 2014. Resposta de biomarcadores em *Amphistegina spp*. (Amphistgenidae, Foraminifera) exposto ao cobre e acidificação marinha. MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(25) Laura Fernandes de Barros Marangoni. 2014. Biomarcadores para avaliação dos efeitos do cobre no coral *Mussismilia harttii* (Cnidaria, Scleractinia, Mussidae). MSc Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

PhD Thesis

(1) Indianara Fernanda Barcarolli. 2009. Influência de parâmetros físico-químicos na acumulação e mecanismo de toxicidade do cobre no isópodo *Excirolana armata*. 2009. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(2) Camila de Martinez Gaspar Martins. 2010. Acumulação e toxicidade do cobre no siri-azul *Callinectes sapidus*. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(3) Thaís Martins Lopes. 2010. Mecanismos de transporte iônico e de acumulação e toxicidade aguda do cobre em células do manto do marisco branco *Mesodesma mactroides* Deshayes, 1854. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(4) Tatiana Ramos Ávila. 2011. Produção secundária baseada no crescimento de crustáceos: aspectos metodológicos. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(5) Hassan A. Al-Reasi, 2012. Quantifying the direct and indirect effects of dissolved organic matter (DOM) on aquatic organisms: interaction with pH and quality measures. Ph. D. thesis, Dept. of Biology, McMaster University, Hamilton, Canada.

(6) Joel S. Klinck, J.S. 2012. Cadmium and calcium transport along the gastro-intestinal tract of rainbow trout: more than “Gut Feelings” on mechanisms of uptake. Ph. D. thesis, Dept. of Biology, McMaster University, Hamilton, Canada.

(7) Mariana Machado Lauer. 2012. Efeito do cobre na atividade de enzimas-chave do metabolismo em animais estuarinos e marinhos. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(8) Marianna Basso Jorge. 2012. Mecanismos de toxicidade do cobre em juvenisde bivalves dulcícola (*Lampisilis silicoides*) e marinho (*Mesodesma mactroides*). PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(9) Sandra Carvalho Rodrigues. 2012. Influência da matéria orgânica dissolvida dulciaquícola e marinha na acumulação e toxicidade do cobre no copépode *Acartia tonsa*. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

(10) Viviana Lisboa da Cunha. 2012. Avaliação do comportamento osmorregulatório da tainha *Mugil liza*: implicações para sua produção em cativeiro. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

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(14) Cinthia Carneiro da Silva. 2014. Fibropapilomatose em fêmeas juvenis da tartaruga marinha verde *Chelonya midas*: Indicadores sanguíneos e envolvimento de metais na etiologia da doença. PhD Thesis, Universidade Federal do Rio Grande. Supervisor: Adalto Bianchini.

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viii. Media coverage (articles in local or international media)

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(2) Bianchini, A. 2010. A diversidade da biologia aquática está afetada pela poluição. Diário Popular, 09 Oct. 2010, Rio Grande, RS, Brazil.

(3) Bianchini, A.; Wood, C.M. 2010. McMaster Canadian Research Chair partners with IDRC-funded Research Chair in Brazil, McMaster University – International Development, November 2010, Hamilton, ON, Canada.

(4) Oliveira, M.N.C. 2011. A gestão ambiental no município de Rio Grande, Rio Grande, RS, Brazil.

(5) Secretaria Municipal do Meio Ambiente. 2012. COMDEMA apoia preservação dos corpos hídricos. Jornal Agora. Rio Grande, RS, Brazil.

(6) Lacerda, L.D. ; Mello, S.L.M. ; BIANCHINI, A. ; OLIVEIRA FILHO, E. C. 2012. Mistérios do mar profundo. Ciência Hoje, Rio de Janeiro, p. 57 - 59, 01 out. 2012.

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monitoramento da qualidade dos recursos hídricos no município do rio grande e dá outras providências. Jornal Agora, 11 July 2014, p. 13.

ix. Other

Databank:

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Electronic media:

(1) INCT-TA. Instituto Nacional de Ciência e Tecnologia (INCT-TA). Website, Rio Grande, RS, Brazil, (www.inct-ta.furg.br).

(2) FURG-TV. Recursos hídricos e desafio do desenvolvimento sustentável. Universidade Federal do Rio Grande, Rio Grande, RS, Brazil, (http://www.inct-ta.furg.br/english/difusao/Recursos.wmv).

(3) FURG-TV. Ciência & Sociedade I. Universidade Federal do Rio Grande, Rio Grande, RS, Brazil, (http://www.inct-ta.furg.br/english/difusao/CS1.wmv).

(4) FURG-TV. Ciência & Sociedade II. Universidade Federal do Rio Grande, Rio Grande, RS, Brazil, (http://www.inct-ta.furg.br/english/difusao/CS2.wmv).

(5) FURG-TV. Ciência & Sociedade III. Universidade Federal do Rio Grande, Rio Grande, RS, Brazil, (http://www.inct-ta.furg.br/english/difusao/CS3.wmv).

(6) FURG-TV. Ciência & Sociedade IV. Universidade Federal do Rio Grande, Rio Grande, RS, Brazil, (http://www.inct-ta.furg.br/english/difusao/CS4.wmv).

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Technical courses:

(1) Bianchini, A. 2010. Modelagem ecotoxicológica para monitoramento da contaminação aquática por metais. October 26-28, Santa Cruz, ES, Brazil.

(2) Bianchini, A.; Martins, S.E.G. 2010. Monitoramento da contaminação aquática por metais: Aplicações do Modelo do Ligante Biótico. IV Congresso Brasileiro de Oceanografia, May 17-21, Rio Grande, RS, Brazil.

(3) Bianchini, A.; Martins, S.E.G. 2010. O Modelo do Ligante Biótico e suas aplicações em ecotoxicologia. XI Congresso Brasileiro de Ecotoxicologia (XI ECOTOX), September 19-23, Bombinhas, SC, Brazil.

(4) Bianchini, A. 2011. O modelo do ligante biótico e suas aplicações em ecotoxicologia. IV Workshop e I Simpósio de Ecotoxicologia, October 10-12, Rio Claro, SP, Brazil.

(5) Martins, S.E.G. 2012. O modelo do ligante biótico. XII Congresso Brasileiro de Ecotoxicologia, 25 September, 2012, Porto de Galinhas, PE, Brazil.

(6) Bianchini, A. 2013. Biotic Ligand Model for Metals: Theoretical Basis and Its Application in Ecotoxicological Studies. Universidad Nacional Autónoma de México, October 4-14, Mexico City, Mexico.

(7) Jorge, M.B.; Bianchini, A. 2014. O Modelo do Ligante Biótico (BLM) e suas aplicações em Ecotoxicologia. XIII Congresso Brasileiro de Ecotoxicologia, September 23-26, Guarapari, ES, Brazil.

Appendix

List of Additional Funding Related to the IRCI research program

Project title	Funding Agency	Your role in the project	Start date (year) / end date (year)	Value (indicate currency)
National Institute of Science and Technology of Aquatic Toxicology (INCT-TA)	Brazilian National Council for Research and Development (CNPq)	Bianchini - Leader and Principal Investigator	2009/2014	2,633,502.55 Brazilian Reais
Biomarkers of contaminants in coastal and marine environments.	Brazilian Ministry of Education (CAPES)	Bianchini - Leader and Principal Investigator	2009/2014	1,924,637.19 Brazilian Reais
Compliance tools development to predict acute and chronic bioavailability in marine versus estuarine waters	International Copper Association	Bianchini -Leader and Principal Investigator	2009/2014	120,000.00 US Dollars
Natural organic matter extraction for use in toxicity tests: Development of an estuarine and marine Biotic Ligand Model for Zn and Pb	International Zinc Association	Bianchini-Leader and Principal Investigator Wood - Collaborator	2009/2014	11,500.00 US Dollars
Interactive effects of water salinity and dissolved organic matter on zinc toxicity in the euryaline copepod *Acartia tonsa*: Implications for the development of a marine and estuarine Biotic Ligand Model	International Zinc Association	Bianchini - Leader and Principal Investigator	2009/2014	20,000.00 US Dollars
Biotic Ligand Model development for Zn and Pb in estuarine and marine waters: interactive influences of salinity and Dissolved Organic Carbon.	International Zinc Association, International Lead-Zinc Research Organization, NSERC CRD Program	Wood- Leader and Principal Investigator Bianchini - Collaborator	2010/2014	Can $ 114,084 (NSERC $64,084, Industrial Partners $50,000)
Towards marine/estuarine Biotic Ligand Models for Cu, Pb, Zn and Ni: chemical and biological Aspects	International Zinc Association, International Lead-Zinc Research Organization, Nickel Producers Environmental Research Association, Vale Inco, Teck Resources, NSERC CRD Program	Wood – Collaborator Bianchini - Collaborator	2011/2015	Can $ 790,924 (NSERC $491,640, Industrial Partners $299,284)
Mechanisms of acute copper toxicity: comparative analysis	Brazilian National Council for Research and	Bianchini - Leader and Principal	2011/2014	128,400.00 Brazilian Reais

in estuarine and marine invertebrates	Development (CNPq)	Investigator		
Evaluating the relative contributions of waterborne and dietary lead exposures to toxicity in rainbow trout	ILZRO (International Lead Zinc Research Organization)	Wood - Leader and Principal Investigator	2011/2014	Can. $77,650
National Institute of Science and Technology in Aquatic Toxicology	Brazilian Ministry of Education (CAPES)	Bianchini - Leader and Principal Investigator	2011/2014	236,037.10 Brazilian Reais
Metal Mixtures in the Environment	Environment Canada	Wood - Leader and Principal Investigator	2012/2016	Can. $83,3000
Transport and Metabolism in Fish	NSERC Discovery Program	Wood - Leader and Principal Investigator	2012/2017	Can. $746,500
Metal Toxicity to Marine Invertebrates	NSERC CRD Grant Program + ILZRO and IZA	Wood- Leader and Principal Investigator Bianchini - Collaborator	2010/2014	Can. $64,144
Operating Support for Bamfield Marine Sciences Centre	NSERC MRS Program	Wood – Collaborator Bianchini - Collaborator	2011/2014	Can. $400,000
Science Without Frontiers Fellowship	Brazilian National Council for Research and Development (CNPq)	Wood - Leader and Principal Investigator	2012/2015	BRL 82,318 Brazilian Reais
LOF Supplement: Upgrade to Confocal Microscope	CFI	Wood -Leader and Principal Investigator	2012/2015	Can. $37,000
Transdisciplinary capacity to study the effects of environmental stressor in coral reefs	Brazilian Ministry of Education (CAPES)	Bianchini - Collaborator	2014/2019	794,608.52 Brazilian Reais
National Institute of Science and Technology in Aquatic Toxicology	Brazilian Ministry of Science and Technology (CNPq)	Bianchini - Leader and Principal Investigator	2013/2014	1,000,000.00 Brazilian Reais
National Institute of Science and Technology in Aquatic Toxicology	Brazilian Ministry of Education (CAPES)	Bianchini - Leader and Principal Investigator	2013/2014	60,000.00 Brazilian Reais
Application of the Biotic Ligand Model (BLM) and environmental biomarkers as tools for evaluation of water resources quality in the main	Foundation for Research Support in the Rio Grande do Sul State (FAPERGS	Bianchini - Leader and Principal Investigator	2013/2015	180,000.00 Brazilian Reais

watersheds of the coastal zone in Rio Grande do Sul State				
Interactive effects of water salinity and dissolved organic matter on zinc toxicity in the euryaline copepod Acartia tonsa: Implications for the development of a marine and estuarine Biotic Ligand Model	International Zinc Association (IZA)	Bianchini - Leader and Principal Investigator	2013/2014	Cd$ 8,800.00
Development of experimental data for a multi-metal BLM framework – back to basics	International Zinc Association (IZA)	Wood - Leader and Principal Investigator	2013/2016	Cd$ 108,250.00
Development of experimental data for a multi-metal Biotic Ligand Model – back to basics	NSERC CRD Program	Wood - Leader and Principal Investigator	2013/2016	Cd$ 141,000.00
Fish behavioural choice system	NSERC RTI Program	Wood - Leader and Principal Investigator	2013/2014	Cd$ 38,179.00
Environmental studies on the ecotoxicology of metals	Rio Tinto	Wood - Leader and Principal Investigator	2013/2014	Cd $16,000.00
Development of water quality guidelines for Pb and Fe	Windward Environmental	Wood- Leader and Principal Investigator	2013/2014	Cd $5,250.00
Biomarkers for evaluation of responses to global climate changes and local impacts in Brazilian coral reefs	Brazilian Ministry of Science and Technology (CNPq)	Bianchini - Leader and Principal Investigator	2014/2017	120.000,00 Brazilian Reais